DOCUMENT RESUME

ED 221 982 EC 150 050

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TITLE	A Gifted and Talented Curriculum Handbook for Science in the Intermediate Grades of Lee County's Department of Exceptional Children. Gifted and Talented Resource Program, Grades 4-6.
INSTITUTION	Sanford - Lee County Schools, N.C.
SPONS AGENCY	North Carolina State Dept. of Public Instruction, Raleigh. Div. for Exceptional Children.
PUB DATE	Jul 81
NOTE	178p.
EDRS PRICE	MF01/PC08 Plus Postage.
DESCRIPTORS	Acoustics; Affective Objectives; Botany; Electricity; *Gifted; Intermediate Grades; *Learning Activities; *Learning Theories; Light; Magnets; Models; *Objectives; *Science Curriculum; Teaching Methods; *Units of Study; Weather

ABSTRACT

Intended for regular classroom teachers in intermediate science classes serving the gifted and talented student, the curriculum handbook is designed to give a basic understanding of gifted education, to list appropriate goals and objectives for the gifted student, and to suggest materials and strategies for implementation within the regular classroom. The philosophy of the Lee County School System (Sanford, North Carolina) is mentioned, traits common to intellectually gifted students are listed, and a definition of giftedness is offered on initial pages of the document. In the next section, student objectives are outlined for 17 goals which include using abstractions in particular and concrete situations, developing productive and divergent thinking skills through generating responses, and being aware of a broad range of feelings. A section on learning theories explains B. Bloom's Taxonomy model in terms of knowledge, comprehension, application, analysis, synthesis, and evaluation. Also provided are a table of an instructional model in the realm of feelings, a graphic illustration of a model for implementing cognitive-affective behaviors in the classroom, and charts of teacher and pupil behaviors. F. Williams' model of thinking behaviors is also considered. A methodology section describes the techniques of brainstorming, the inquiry process, and thinking operations. The bulk of the document consists of five science units on sound, light, magnetism and electricity, weather, and plants. Each unit (with the exception of the sound unit) is presented in two parts--teacher plans and strategies, and a student guidebook. Within units are students' activities, worksheets, illustrations, and suggested resources. Appended is a 16 page booklet entitled "A Handbook about Gifted Education for Parents, Teachers, and You." (SW)

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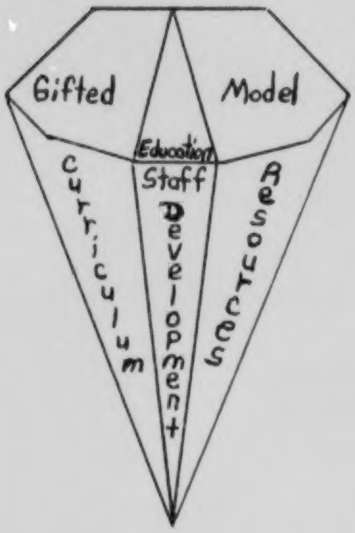
A Gifted & Talented Curriculum Handbook for Science in the Intermediate grades of Lee County's Department of Exceptional Children

Gifted & Talented Resource Program
grades 4 - 6
Lee County Schools
Sanford, North Carolina

EC/150050


Gifted
Model
Education
Staff
Development
Curriculum
Resources

This booklet was developed as part of Project GEM (Gifted Education Model) with funds from a United States Office of Education Gifted and Talented Subgrant, administered by the Division for Exceptional Children, Reference #148, North Carolina State Department of Public Instruction, Raleigh, North Carolina. July, 1981.

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Better

is one's Own Path
though imperfect
than the Path
of Another
Well made

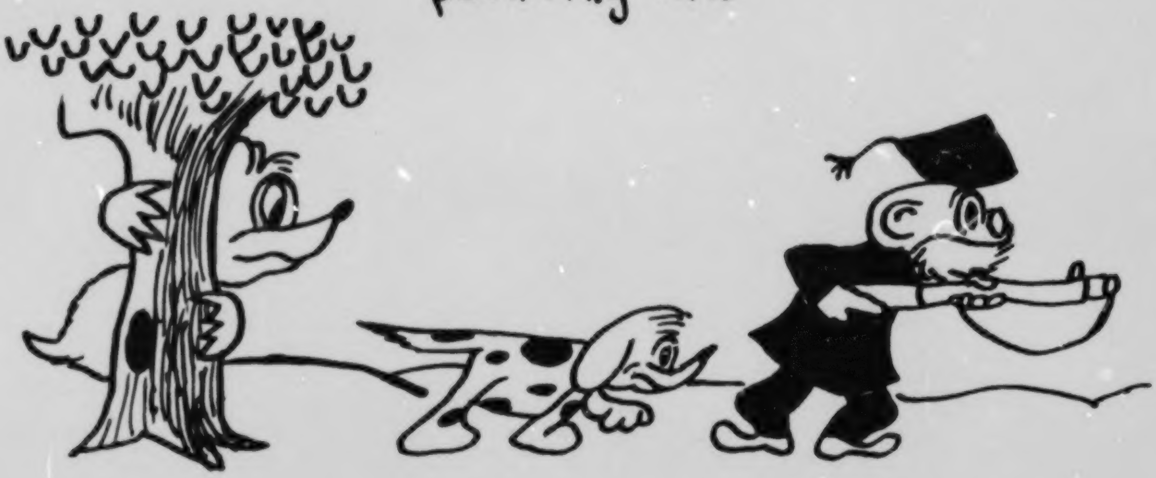
INTRODUCTION

A *Gifted and Talented Curriculum Handbook for Science in the Intermediate Grades* has been developed to assist regular classroom teachers in intermediate science classes in the Lee County School System to provide appropriate experiences for gifted students. It is designed to give a basic understanding of gifted education, to list appropriate goals and objectives for the gifted student, and to suggest materials and strategies for implementation within the regular classroom. This guide is developed in an effort to facilitate a program of individualized instruction for all students in the Lee County School System.

PHILOSOPHY

The Lee County School System is committed to a philosophy that every child has the right to discover and develop his/her full potential and self-actualization. In keeping with this philosophy, the Gifted and Talented Program is designed to provide extensions of the regular classroom learning experience by giving students the following opportunities: to explore in-depth their interests, to develop higher level thought processes involving analyzing, synthesizing, and evaluating, to develop productive and divergent thinking, to explore the process of inquiry, to interact with their intellectual peers, and to pursue self-directed goals.

Harvey thinks he's a pointer and tries hard to be helpful. But he points with his tail and he can't figure out why nobody knows what he's pointing at.



TRAITS COMMON TO INTELLECTUALLY GIFTED STUDENTS*

1. Displays a great curiosity about objects, situations, or events. Has the capacity to look into things and be puzzled; gets involved with many exploratory type activities, is interested in a wide range of things.
2. Is a self-initiated student, usually needing little help in knowing what to do; starts on his own; pursues individual interests and seeks own direction.
3. Reveals originality in oral and written expression. Consistently gives unusual, clever, unique responses or ideas away from the cliche or sterotype.
4. Has unusual talent to express himself in the arts; i.e., music, dance, drama, drawing, play activities and/or artistic expression.
5. Has the ability to generate many alternatives. Seeks many directions and is flexible in thinking by going at right angles to the main stream of thought in the classroom.
6. Is perceptually open to his environment. Uses all of his senses to be aware of things around him; keenly observant and alert to things that are done as well as things that are not done.
7. Displays a willingness for complexity. Thrives on problem situations; selects a more difficult response, solution, or problem over the easier; seeks complex, asymmetrical forms compared to symmetrical forms; has a preference for "digging in" to things.
8. Has the capacity to use knowledge and information other than to memorize, store and recall. Seeks new associations among items of information; combines elements of materials or knowledge in a unique fashion.
9. Shows superior judgment in evaluating things. Reasons things our; seeks logical answers; can see implications and consequences; makes decisions easily.
10. Is a good elaborator. Produces a variety of detailed steps; continually adds on to ideas, responses, or solutions; loves to embellish materials and ideas.
11. Is a good guesser. Is able to hypothesize; is full of wonder about things; is a risk-taker; makes good educated guesses.
12. Makes consistently good grades in most subjects.
13. Learns rapidly, easily, and efficiently.
14. Has the ability to see relationships among unrelated facts, information or concepts.
15. Uses a lot of common sense; seeks the most practical approach.
16. Retains and uses information which has been heard or read.
17. Uses a large number of words easily and accurately.
18. Asks many questions of a provocative nature; inquisitive about knowing why instead of what; has the capacity to inquire.
19. Performs academically at a level two years in advance of the class on one or more disciplines of knowledge.

---

*From Creative Production in the Classroom by Frank Williams and Robert Eberle (p. 38).

DEFINITION OF GIFTED AND TALENTED

Department Of Public Instruction

Gifted and talented students are defined as those students who (1) possess demonstrated or potential intellectual, creative or specific academic abilities and (2) need differentiated educational services beyond those being provided by the regular school program in order to realize their potentialities for self and for society. A student may possess singularly or in combination these characteristics: general intellectual ability, specific aptitude, creative or productive thinking abilities.

IDENTIFICATION

Identification of gifted and talented students in Lee County consists of a screening and evaluation process which follows the requirements of the State Department of Public Instruction, Division of Exceptional Children.

I THINK YOU'VE GOT THE WRONG ADDRESS!
MEOW

TABLE OF CONTENTS

Philosophy. 7
Traits Common To Intellectually Gifted Students 9
Definition of Gifted and Talented 10
Identification. 10
Goals and Objectives. 11

Learning Theories

A Brief Explanation of Bloom's Taxonomy. 19
Instructional Model in the Realm of Feelings 23
A Model for Implementing Cognitive-Affective Behaviors - Frank Williams. 24
Thinking Behaviors: Williams' Model 27

Methodology

Brainstorming. 31
The Inquiry Structure. 32
Ideas On the Inquiry Process 33
Inquiry Process. 34
Thinking Operations by Raths and Wasserman 35

Science Units

Sound

Bulletin board ideas. 41
Student guidebook 44

Light

Teacher plans and strategies. 67
Student guidebook 73

Magnetism and Electricity

Teacher plans and strategies. 91
Student guidebook 99

Weather

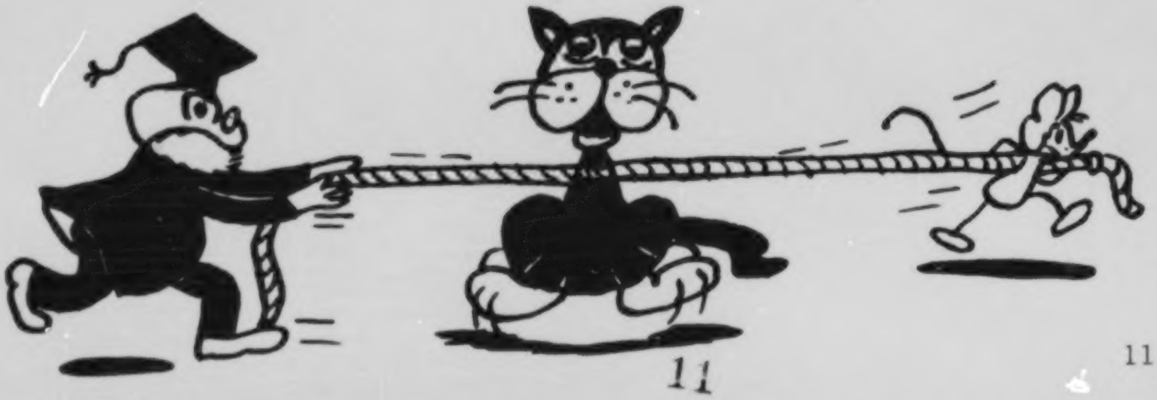
Teacher plans and strategies. 121
Student guidebook 125

Plants

Teacher plans and strategies. 139
Student guidebook 153
General References. .171
A Handbook About Gifted Education 175

GOALS AND OBJECTIVES

The goals and objectives of the Gifted and Talented Program in Lee County are student oriented. After evaluating the special needs of the gifted student, the regular classroom teacher can choose from these goals and objectives, which are categorized as either cognitive or affective, those which are needed to develop the Individualized Education Plan. These goals and objectives incorporate Bloom's Taxonomy in the Cognitive Domain, Raths and Wasserman's Thinking Operations, William's processes of Teaching For Thinking and Feeling, and Krathwohl's Taxonomy in the Affective Domain.



GOALS AND OBJECTIVES

GOALS AND OBJECTIVES - COGNITIVE DOMAIN

Goal # 1: To recognize, recall, and understand information. (Comprehension: Bloom)

Objectives:
a. To _compare_ similarities and differences. (Raths and Wasserman Analogies: Williams)
b. To _summarize_ in brief or condensed form the substance of what has been presented. (Raths and Wasserman)
c. To _observe_ using a variety of senses to distinguish between fact and assumption. (Raths and Wasserman)
d. To _classify_ into groups according to some principle. (Raths and Wasserman)

Goal # 2: To use abstractions (learned knowledge and ideas) in particular and concrete situations. (Application: Bloom)

Objectives:
a. To _apply facts and principles in a new situation_ by seeing relationships, detecting what belongs together in a new context, and separating what is relevant from what is irrelevant. (Raths and Wasserman)
b. To _solve problems_ by using the whole of ideas and skills rather than solely with the parts. (Application; Bloom)

Goal # 3: To break down or communicate into parts. (Analysis: Bloom)

Objectives:
a. To perceive common notions not necessarily true in fact or to perceive self-contradictory statements or observations. (Paradoxes: Williams)
b. To discern inherent properties, conventional symbols or identities, and ascribing qualities. (Attributes: Williams)
c. To realize gaps of limitations of knowledge, missing links in information, and/or what is not known. (Discrepancies: Williams)
d. To respond to inquiries to bring forth meaning and to summons to discover new knowledge. (Provocative questions: Williams)
e. To search for the current status of something. (Skills of descriptuve search: Williams)
f. To analyze traits of eminently creative people, study processes which lead to problem solving, inventing, incubation, and insight. (Study of Creative People and Process: Williams)
g. To interpret by explaining the meaning something has for the individual. (Facts, inferences, and generalizations: Raths and Wasserman)
h. To look for assumptions where a conclusion is drawn. (Raths and Wasserman)

Goal # 4: To put elements or parts together to form a new whole. (Synthesis: Bloom)

Objectives:
a. To demonstrate the dynamics of things by making alterations, modification, or substitutions. (Examples of Change: Williams)

b. To use a familiar structure to go at random to build another structure or demonstrate an example from which new approaches occur at random. (Organized Random Search: Bloom)
c. To interpret, resolve, and/or decode situations which puzzle, intrigue, or challenge thinking or openended situations which do not force closure. (Tolerance for Ambiguity: Williams)
d. To develop a mind-set for using information that is read or to generate ideas by reading. (Creative Reading Skill: Williams)
e. To listen for information allowing one thing to lead to another or to generate ideas by listening. (Creative Listening Skill: Williams)
f. To stretch the imagination to form some kind of idea about that which is not actually present or has never been wholly experienced. (Raths and Wasserman)
g. To forecast by listing causes of a given situation and predicting the many effects of that given situation.

Goal # 5: To make judgements about the value of materials, methods, or ideas for a given purpose. (Evaluation: Bloom)

Objectives:
a. To criticize by using the good, worthy and average as well as the poor and unworthy. (Raths and Wasserman)
b. To code one's own work to increase responsibility for one's own thinking. (Raths and Wasserman)
c. To adjust to development by learning from mistakes or failures and developing as many options as possible. (Williams)
d. To decide upon possibilities by their consequences and implications or by checking and verifying ideas and guesses against the facts. (Evaluate Situations: Williams)
e. To set up appropriate standards or criteria from which to measure. (Bloom)

Goal # 6: To be a productive and divergent thinker through generating responses. (Williams)

Objectives:
a. To generate a fluency of ideas and responses. (Torrance)
b. To show flexibility of thought by detouring in direction, shifting categories, changing strategies or separating into kinds of ideas. (Torrance)
c. To produce original thinking through unusual, novel, unique, clever, remote, far-fetched or away from the obvious responses. (Torrance)
d. To elaborate on an idea by adding detail, embellishing, stretching, expanding, implying, or embroidering a simple idea to make it more elegant. (Torrance)
e. To participate in the creative process through one or all of the main stages of preparing, incubating, illuminating, and verifying. (Gallagher)

Goal # 7: To experience a variety of communication skills.

Objectives for Oral Communication:
a. To organize words into meaningful networks of ideas to describe spontaneously and easily one's feelings, values, ideas, needs and opinions.

b. To express oneself or one's ideas, thoughts, feelings, and experiences through visual art forms; music, drawings, movement, drama, storytelling, or other sensory method.
c. To prepare a speech, unit or lesson and present it to the class using good public speaking principles; eye to eye contact with listeners, good voice projection and absence of unnecessary words.

Objectives for Written Communication:
a. To generate and communicate ideas and interpretations through writing. (Creative Writing Skill: Williams)
b. To write various genres, prose, and verse including haiku, free verse, stories, fables, skits, drama, etc. (Creative Writing Skill: Williams)

Goal # 8: To incorporate the planning steps in attacking any problem, project, field trip, or product.

Objective - To apply the four planning steps:
a. Identification of a project, product, or field trip.
b. Organization of materials, time, and resources.
c. List steps in sequence, order.
d. Think ahead of possible problems that might arise and how to prevent them.

Goal # 9: To develop skills in problem-solving and decision-making.

Objectives:
a. To enumerate as many alternatives as possible to a given problem or situation.
b. To compare, state relationships among alternatives, and weigh the values of alternatives according to one's needs or goals.
c. To make a choice among alternatives.
d. To substantiate and defend one's choice.

Goal # 10: To learn to use the Scientific Inquiry Process independently to experiment, solve problems, or follow through on hunches.

Objectives:
a. To identify a problem or topic to investigate.
b. To analyze what is not known about the problem or topic.
c. To hypothesize what the answer will be, whether correct or not.
d. To investigate by using as many learning styles (auditory, visual, oral, olfactory, tactile, or taste) as possible to find evidence to prove or disprove the hypothesis.
e. To form a conclusion concerning validity of hypothesis.
f. To communicate the investigation to the class through as many communication styles (oral, sound, three-dimensional, movement, paintings, debates, products, etc.) as possible.
g. To evaluate one's own investigation in terms of:
    1) quality of product and validity of process used
    2) depth of study
    3) interest of topic and means of communication
    4) practicality of study and product
    5) degree to which study stimulates further learning

Goal # 11: To cultivate one's own leadership ability to its fullest potential.

Objectives:
- a. To articulate ideas to a group in such a way that they comprehend and remain interested.
- b. To recognize, state, and prioritorize goals and follow through on their accomplishment.
- c. To acknowledge responsibilities expected of a group, divide the responsibilities equally and to match the assignments to the members of the group.
- d. To organize other class members for such products as plays, debates, presentations, etc.
- e. To openly display trust, respect, warmth, and appreciation for others. (Krathwohl)

  Note: To be accepted as a leader, one must successfully accomplish the upper three levels of Krathwohl's Affective Feeling Levels.

GOALS AND OBJECTIVES - AFFECTIVE DOMAIN

Goal # 12: To sense and be personally aware of a broad range of feelings.

Objectives:
- a. To become conscious of situations and events that trigger a flow of feelings.
- b. To verbalize, describe, and explain attitudes and feelings.
- c. To comfortably engage in conversation regarding things that are a source of pleasure or discomfort.
- d. To anticipate the kinds of feelings that may be aroused in oneself and others. (Objectives by Eberle and Hall)

Goal # 13: To respond to feelings through the arts: music, drama, poetry, and visual art. (Willingness to Respond: Krathwohl)

Objectives:
- a. To represent visually and/or artistically a variety of feelings.
- b. To draw on past experiences for the purpose of understanding and internalizing the feelings represented.
- c. To gain feelings for or about situations and events.
- d. To identify moods and feelings in the expression of others. (Objectives from Eberle and Hall)

Goal # 14: To interact and share points-of-view concerning interpersonal relationships. (Valuing: Krathwohl)

Objectives:
- a. To establish a sense of personal identity through interaction.
- b. To openly associate oneself with situations and events that generate feelings.
- c. To experience emotional involvement in the discussion of problems which center on interpersonal relationships.
- d. To display a willingness and a desire to deal straight forwardly with social situations. (Objectives from Eberle and Hall)

Goal # 15: To explore feelings through expressions of regard. (Organizing a Value System: Krathwohl)

Objectives:
- a. To experiment with new and improved ways of relating.
- b. To reflect positive changes in attitude and expression.
- c. To demonstrate positive regard for others.
- d. To express positive feelings for others frequently and naturally. (Objectives from Eberle and Hall)

Goal # 16: To experience conditions of trust, respect, appreciation and affection. (Characterization: Krathwohl)

Objectives:
- a. To openly display trust, respect, warmth, and appreciation for others.
- b. To discover and evaluate gains in personal effectiveness.
- c. To view one's own behavior as a model for others.
- d. To express the need for human relationships as requirement for a civilized society. (Objectives from Eberle and Hall)

Goal # 17: To experience as inward feeling-process that motivates one to do something with information. (Williams)

Objectives:
- a. To be a risk taker by having the courage to expose oneself to failure or criticisms, to take a guess, to function under conditions devoid of structure or to defend one's own ideas. (Williams)
- b. To experience complexity by being challenged to seek many alternatives, seeing gaps between how things are and how they could be, bringing order out of chaos or delving into intricate problems or ideas. (Williams)
- c. To show curiosity by being willing to be inquisitive and to wonder, to toy with an idea, to be open to puzzling situations, to ponder the mystery of things, and to follow a particular hunch just to see what will happen. (Williams)
- d. To let one's imagination have the power to visualize and build mental images, to dream about things that have never happened, to feel intuitively, and to reach beyond sensual or real boundaries. (Williams)

Learning Theories

A BRIEF EXPLANATION OF BLOOM'S TAXONOMY

I. KNOWLEDGE

In the Taxonomy Knowledge refers to the ability to recognize or recall information. It should not be confused with a philosophical definition. Teaching this phase of the taxonomy merely involves "pouring in" information.

This phase of instruction is usually accomplished in a formal setting. It can be accomplished with very large groups.

A. Activities usually done by student:

1. Responds to classroom situation--is attentive
2. Absorbs information--looks, listens, reads
3. Remembers
4. Practices effective procedures--drills, recites
5. Covers information in books
6. Recognizes information that has been covered

B. Evidence of student's success:

1. Completes class and homework assignments
2. Completes programmed learning sequences
3. Scores satisfactorily on objective tests

C. Activities usually done by teachers:

1. Directs student activities
2. Gives information--lectures, drills
3. Shows information--audio-visuals, demonstrations
4. Enlarges information
5. Makes and administers objective tests
6. Makes homework assignments

II. COMPREHENSION

Comprehension represents the lowest level of understanding. The student should be able to make some use of the knowledge that he has gained but he may not necessarily be able to relate it to other material or see its fullest implications.

This instruction is usually accomplished in a formal setting with a group no larger than a typical class.

A. Activities usually done by student:

1. Explains information rather than merely quotes it
2. Makes simple demonstrations
3. Translates information into his own words
4. Extends information to new situations
5. Interprets information from technical terms to familiar terms

B. Evidence of student's success:

1. Has the ability to intelligently discuss information
2. Can write simple essays
3. Scores satisfactorily on objective tests

C. Activities usually done by teachers:

1. Demonstrates material
2. Listens to students
3. Asks questions
4. Compares and contrasts students' answers
5. Examines students' ideas
6. Makes and administers objective tests and low level essay tests
7. Makes carefully selected homework assignments

III. APPLICATION

Application refers to the ability to use abstractions in particular and concrete situations. An example of this phase could be the using of an abstract mathematical formula to solve a specific math problem. In this phase instruction is usually rather informal. It is readily adaptable to laboratories, shops, the field, the stage, or to small groups within the classroom.

A. Activities usually done by students:

1. Solves novel problems
2. Constructs projects, models, apparatus, etc.
3. Demonstrates use of knowledge

B. Evidence of students' success:

1. Masters problem solving tests
2. Constructs equipment, models, graphs, etc.
3. Demonstrates ability to use equipment

C. Activities usually done by teachers:

1. Shows students ways to facilitate their work
2. Observes students' activities
3. Criticizes students' activities
4. Helps design students' projects
5. Organizes field trips and contests

IV. ANALYSIS

Analysis refers to the breaking down of a communication into its basic parts. This allows the relationship between ideas to be seen more clearly and allows basic arrangements to be studied. This phase of instruction is best conducted in an informal and irregular manner. Small group and independent study techniques are especially useful here. Homework assignments directed toward analysis have been especially valuable.

A. Activities usually done by students:

1. Discusses information in depth
2. Uncovers interrelationships among ideas
3. Discovers deeper meanings and insinuations that were not apparent at first
4. Sees similarities and differences between styles

B. Evidence of students' success:

1. Makes effective outlines
2. Writes effective precis
3. Completes effective experimental write-ups

C. Activities usually done by teachers:

1. Probes, guides, and observes students
2. Acts as a resource person
3. Plans for and conducts discussions, seminars, and group critiques

V. SYNTHESIS

Synthesis is the putting together of elements or parts so as to form a whole. It is the arranging and combining of pieces to form a pattern or structure that was not clearly evident before. This phase of the Taxonomy is especially adaptable to independent study. It can be accomplished in almost any setting including the home. The library is especially useful. Much reflection is generally required--these results often come slowly. Patience is necessary.

A. Activities usually done by students:

1. Produces unique communications
2. Formulates new hypotheses based on analyzed information
3. Makes discoveries and generalizations
4. Shows relationships between ideas and philosophies
5. Propose new ways of doing things

B. Evidence of students' success:

1. Activities above are effectively completed
2. Writes quality essays and term papers
3. Makes blue prints or sets of plans for projects

C. Activities usually done by teachers:

1. Extends students' knowledge
2. Analyzes and evaluates students' work
3. Prepares reading lists--including critical questions
4. Brings in consultants
5. Plans seminars
6. Allows for independent study

VI. EVALUATION

Evaluation involves making judgments about the value of materials, methods, or ideas for a given purpose. This represents the highest level of intellectual functioning. This process is difficult for even the brightest students. Results should not be expected to come quickly. Students should not feel rushed. This phase must be taught in a very informal manner and is handled best in small groups.

A. Activities usually done by students:

1. Makes firm commitments
2. Judges quality based on sound criteria
3. Effectively supports or disputes ideas, theories, etc.

B. Evidence of students' success:

1. Oral and written critiques are logical
2. Speeches and essays are based on sound information
3. Projects are completed successfully
4. Performance is effective (athletic, artistic, musical, etc.)

C. Activities usually done by teachers:

1. Accepts students' ideas
2. Plans competitive essay assignments
3. Plans tournaments (speech, debates, etc.)
4. Helps establish criteria for evaluations

Figure 1.

Instructional Model in the Realm of Feelings

Resembling a Taxonomy of Educational Objectives, the Instructional Model describes educational goals and classifies behaviors which give direction to the learning processes in both the **Cognitive** and **Affective Domains.**

FEELING EXPERIENCES		THINKING EXPERIENCES	
Level:	**[Affective][1]**	**Level:**	**[Cognitive][2]**
I.	Sensing and being personally aware of a broad range of feelings. [Receiving]	I.	Gaining information which makes it possible to identify and define a broad range of feelings. [Knowledge]
II.	Responding to feelings through the arts: music, drama, poetry, and visual art. [Willingness to Respond]	II.	Listening and observing for the purpose of understanding and interpreting moods and feelings. [Comprehension]
III.	Interacting and sharing points-of-view concerning interpersonal relationships. [Valuing]	III.	Verifying situations and generalizing about problems involving social interaction. [Application - Analysis]
IV.	Exploring feelings through expressions of regard and disregard. [Organizing a Value System]	IV.	Creating ideas which build and support positive relationships. [Synthesis]
V.	Experiencing conditions of trust, respect, appreciation and affection. [Characterization]	V.	Affirming the strength and power of interpersonal regard as a force for the enhancement of the individual and society. [Evaluation]

The ultimate goal is a **community** in which: interpersonal bonds have been established, a higher level of human nature exists, and the sharing of psychic energy becomes possible.

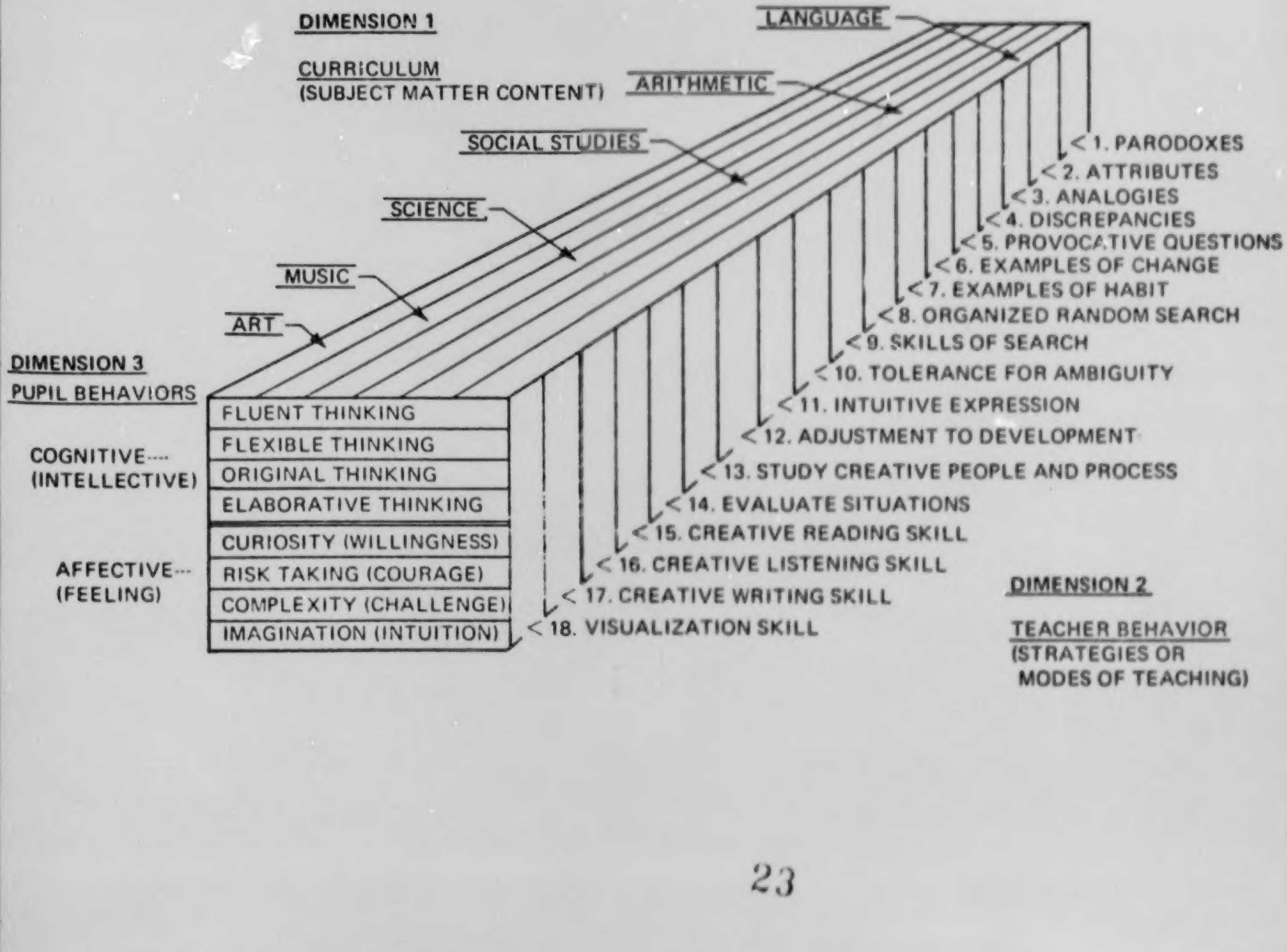
1. **Taxonomy of Educational Objectives, Handbook II: Affective Domain, Krathwohl [7.].**

2. **Taxonomy of Educational Objectives, Handbook I: Cognitive Domain, Bloom [1.]**

References from the above sources have been reprinted with the permission of the publisher, the David McKay Company, Inc., New York.

A Model for Implementing Cognitive-Affective Behaviors in the Classroom

$D1 \rightleftarrows D2 \rightarrow D3$


DIMENSION 1
CURRICULUM
(SUBJECT MATTER CONTENT)
LANGUAGE
ARITHMETIC
SOCIAL STUDIES
SCIENCE
MUSIC
ART
DIMENSION 3
PUPIL BEHAVIORS
COGNITIVE---
(INTELLECTIVE)
FLUENT THINKING
FLEXIBLE THINKING
ORIGINAL THINKING
ELABORATIVE THINKING
AFFECTIVE---
(FEELING)
CURIOSITY (WILLINGNESS)
RISK TAKING (COURAGE)
COMPLEXITY (CHALLENGE)
IMAGINATION (INTUITION)
< 1. PARODOXES
< 2. ATTRIBUTES
< 3. ANALOGIES
< 4. DISCREPANCIES
< 5. PROVOCATIVE QUESTIONS
< 6. EXAMPLES OF CHANGE
< 7. EXAMPLES OF HABIT
< 8. ORGANIZED RANDOM SEARCH
< 9. SKILLS OF SEARCH
< 10. TOLERANCE FOR AMBIGUITY
< 11. INTUITIVE EXPRESSION
< 12. ADJUSTMENT TO DEVELOPMENT
< 13. STUDY CREATIVE PEOPLE AND PROCESS
< 14. EVALUATE SITUATIONS
< 15. CREATIVE READING SKILL
< 16. CREATIVE LISTENING SKILL
< 17. CREATIVE WRITING SKILL
< 18. VISUALIZATION SKILL
DIMENSION 2
TEACHER BEHAVIOR
(STRATEGIES OR
MODES OF TEACHING)

From Classroom Ideas for Encouraging Thinking and Feeling by Frank E. Williams.

DIMENSION 2
Teacher Behaviors
(Strategies)

NO. 1 – PARADOXES	Common notion not necessarily true in fact Self-contradictory statement or observation
NO. 2 – ATTRIBUTES	Inherent properties Conventional symbols or identities Ascribing qualities
NO. 3 – ANALOGIES	Situations of likeness Similarities between things Comparing one thing to another
NO. 4 – DISCREPANCIES	Gaps of limitations in knowledge Missing links in information What is not known
NO. 5. – PROVOCATIVE QUESTIONS	Inquiry to bring forth meaning Incite knowledge exploration Summons to discovering new knowledge
NO. 6 – EXAMPLES OF CHANGE	Demonstrate the dynamics of things Provide opportunities for making alterations, modifications, or substitutions
NO. 7 – EXAMPLES OF HABIT	Effects of habit-bound thinking Building sensitivity against regidity in ideas and well-tried ways.
NO. 8 – ORGANIZED RANDOM SEARCH	Using a familiar structure to go at random to build another structure An example from which new approaches occur at random.
NO. 9 – SKILLS OF SEARCH	Search for ways something has been done before (historical search) Search for the current status of something (descriptive search) Set up an experimental situation and search for what happens (experimental research)
NO. 10 – TOLERANCE FOR AMBITGUITY	Provide situations which puzzle, intrigue, or challenge thinking Pose open-ended situations which do not force closure
NO. 11 – INTUITIVE EXPRESSION	Feeling about things through all the senses Skill of expressing emotion Be sensitive to inward hunches or nudges
NO. 12 – ADJUSTMENT TO DEVELOPMENT	Learn from mistakes or failures Develop from rather than adjust to something Developing many options or possibilities
NO. 13 – STUDY CREATIVE PEOPLE AND PROCESS	Analyze traits of eminently creative people Study processes which lead to problemsolving, invention, incubation, and insight
NO. 14 – EVALUATE SITUATIONS	Deciding upon possibilities by their consequences and implications Check or verify ideas and guesses against the facts
NO. 15 – CREATIVE READING SKILL	Develop a mind-set for using information that is read Learning the skill of generating ideas by reading
NO. 16 – CREATIVE LISTENING SKILL	Learning the skill of generating ideas by listening Listen for information allowing one thing to lead to another
NO. 17 – CREATIVE WRITING SKILL	Learning the skill of communicating ideas in writing Learning the skill of generating ideas through writing
NO. 18 – VISUALIZATION SKILL	Express ideas in visual forms Illustrating thoughts and feelings Describing experiences through illustrations

From Classroom Ideas for Encouraging Thinking and Feeling by Frank E. Williams.

DIMENSION 3

Pupil Behaviors

Behavior	Meaning
COGNITIVE – INTELLECTIVE	
FLUENT THINKING To think of the *most* - -	Generation of a quantity Flow of thought Number of relevant responses
FLEXIBLE THINKING To take *different* approaches - -	Variety of kinds of ideas Ability to shift categories Detours in direction of thought
ORIGINAL THINKING To think in *novel* or *unique* ways - -	Unusual responses Clever ideas Production away from the obvious
ELABORATIVE THINKING To *add on* to - -	Embellish upon an idea Embroider upon a simple idea or response to make it more elegant Stretch or expand upon things or ideas
AFFECTIVE – FEELING	
RISK TAKING To have *courage* to - -	Expose oneself to failure or criticisms Take a guess Function under conditions devoid of structure Defend own ideas
COMPLEXITY To be *challenged* to - -	Seek many alternatives See gaps between how things are and how they could be Bring order out of chaos Delve into intricate problems or ideas
CURIOSITY To be *willing* to - -	Be inquisitive and wonder Toy with an idea Be open to puzzling situations Ponder the mystery of things To follow a particular hunch just to see what will happen
IMAGINATION To have the *power* to - -	Visualize and build mental images Dream about things that have never happened. Feel intuitively Reach beyond sensual or real boundaries

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From Classroom Ideas for Encouraging Thinking and Feeling by Frank E. Williams.

WILLIAMS' MODEL: THINKING BEHAVIORS

Fluent Thinking: The ability to think of the most by producing a number of questions, ideas, solutions or alternatives. A count of these determines how fluent a child is.

Examples of behavior:

The child who has a flow of answers when a question is asked.

The child who draws several pictures when only asked to draw one.

The child who usually has several ideas about something while others struggle for one idea.

The child who asks many questions.

The child who uses a large number of words when expressing himself.

The child who always produces more than others in the class.

The fastest worker in the class who does more than just the assignment.

Flexible Thinking: The ability to take different approaches by producing a variety of questions, ideas, solutions or alternatives. A count of the number of changes or categories within which thinking occurs determines how flexible a child is. Fluent children are not flexible if all their ideas are of one kind.

Examples of behavior:

The child who thinks of various ways to use an object other than its common use.

The child who has different interpretations of a picture, story or problem other than the one being discussed.

The child who can apply a principle or concept in subjects other than the one in which it was introduced.

The child who shifts and takes another point of view or considers situations differently from others in the class.

The child who, when discussing a situation, will always take a different position from the rest of the class.

The child who, when given a problem, usually thinks of a number of different possibilities for solving it.

Original Thinking: The ability to think of unique approaches by producing ideas, questions, solutions or alternatives that others do not think of. A count of the number of uncommon, original responses or productions away from the usual determines how original a child is.

Examples of behavior:

The child who likes objects in the room placed off-side or prefers asymmetry in drawings and designs.

The child who is dissatisfied with a stereotyped answer and instead seeks a fresh approach.

The non-conformist who cannot help being different and always has a new twist in thinking or behaving.

The child who enjoys the unusual and will rebel against doing things the way everyone else does them.

The child who deviates from others to do things his own way.

The child who, after reading or listening to a problem solution, will go to work on inventing his own new solution.

The child who not only questions the old way but will always try to figure out a new way.

Elaborative Thinking: The ability to embellish or expand upon ideas, questions, solutions or alternatives. A count of the number of times he senses something lacking and adds on details to improve it determines how elaborative a child is.

Examples of behavior:

The child who will add lines, colors and details to his own or another child's drawing.

The child who senses a deeper meaning to an answer or solution by producing more detailed steps.

The child who takes off with someone else's idea and modifies it.

The child who will accept an idea or someone else's work but will always want to "jazz it up".

The child who is uninterested in things that are barren or plain and always attempts to add detail to make them more beautiful.

Methodology

BRAINSTORMING*

"The essence of brainstorming's principle of deferred judgment is to allow a given period of time for listing all the ideas that come to one's mind regarding a problem, without judging them in any way."

Four rules of brainstorming:

1. Adverse criticism is taboo.
2. Freewheeling is welcomed.
3. Quantity is wanted.
4. Combination and improvement are sought.

Advantages:

Used individually as well as in group
Develops creative alternatives
Experienced people using brainstorming in an individual process produce an average of 125 percent more good quality ideas than inexperienced people
Counteracts conformity
Produces basic respect for the human personality--builds self-concept

Misuse:

Brainstorming is not mere recall of experiences and ideas. It is not just a conventional conference which produces nothing new--just an interchange of ideas. "However, as a group brainstorms for longer stints of time, it begins to wax more imaginative. It soon begins to run out of ideas that come from memory. At this point there is nothing left to do but to adapt, combine, and rearrange thoughts--and thus to conceive new ideas. The members begin to see new and unusual relationships among their thoughts and experiences--which is the essence of creative thinking." In order to achieve these really creative ideas, some leaders stop the group at end of allotted time and ask if they've had enough time. When the group indicates "yes", the leader then sets them to work for 5 more minutes. That 5 minutes often yields the best answers.

Brainstorming does not produce a genius, but it does improve and increase a person's ability to solve problems.

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*From "Do You Really Understand Brainstorming?" by Sidney J. Parnes, A Source Book for Creative Thinking edited by Sidney Parnes and Harold Harding.

THE INQUIRY STRUCTURE

I. Identify a topic to be investigated by the class, a group or an individual student.

   A. Discuss present understandings and beliefs about the topic.

   B. Discuss what is not known and needs to be known.

II. Make a statement about the topic in the form of a hypothesis. This statement will be accepted as the student's best belief, whether right or wrong.

III. Begin investigations and study.

   A. Find evidence that proves hypothesis correct.

   B. Also find evidence that proves hypothesis incorrect.

   C. Use as many learning styles and thinking processes as possible.

IV. Make a decision concerning validity of hypothesis. In the light of the evidence found that proves and disproves it. Don't be afraid to change opinions about first belief.

V. Communicate the study to the class in as interesting and personal way as possible. Use skits, models, charts, paintings, panels, debates, notebooks, bulletin boards, mobils, as well as written or oral reports. Use as many communication styles as possible.

VI. Evaluation of total procedure:

   A. Quality of product and validity of process used.

   B. Depth of study made by student.

   C. Interest of topic and means of communication.

   D. Practicality of study and product.

   E. Degree to which study stimulates further learning.

GT/7273

IDEAS ON THE INQUIRY PROCESS

Inquiry Process[1]

Positive aspects for student:

1. It encourages independent effort.
2. It broadens the range of thinking.
3. It encourages clear and logical thinking.
4. It is interesting and motivational.
5. It is a confidence-building tool.
6. It encourages utilization of new and varied sources of information.

Positive aspects for teacher:

1. It puts the teacher in a new role:
    a. guide to learning,
    b. question-raiser rather than answerer,
    c. listener,
    d. forces out of a dominant strategy.
2. It encourages teacher to utilize varied sources for materials.

Implications for teacher:

1. Recognize that a change will require additional work for a period of time.
2. Recognize that teacher will play a new role if process is to be successful.
3. Recognize that the key to any change is the attitude of the teacher.

Implications for administrator:

1. Recognize the need for changes in the learning climate.
2. Recognize the need for a variety of learning materials.
3. Recognize that not all teachers want to make changes.

To Use Inquiry Process as Lesson Plan[2]

1. Decide on concept you want to teach.
2. Create appropriate and exciting activities to demonstrate it.
    Activities should include actual use of object or piece of equipment.
    Activity should be written clearly--series of steps.
3. Students should base their conclusions only on what they've discovered.
4. Let students research to establish validity of their conclusions.

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[1] THE GIFTED CHILD QUARTERLY, Autumn 1971

[2] INSTRUCTOR, May 1972

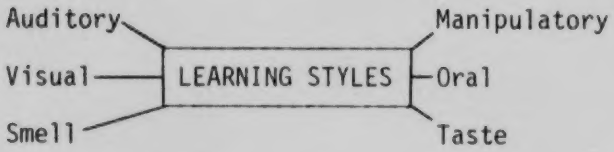
INQUIRY PROCESS

PROBLEM- - - - - - - - - - What do I want to know?

ANALYSIS- - - - - - - - -What do I know/not know about the problem?

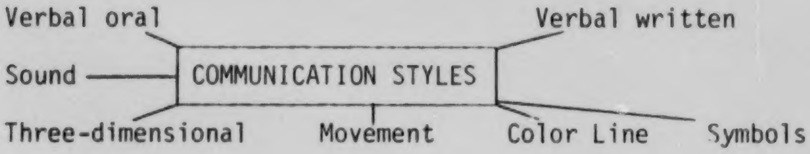
HYPOTHESIS- - - - - - - -What do I think the answer is? statement.

INVESTIGATION


Auditory
Manipulatory
Visual
LEARNING STYLES
Oral
Smell
Taste

CONCLUSION- - - - - - - -What is the answer based on my investigation?

COMMUNICATION


Verbal oral
Verbal written
Sound
COMMUNICATION STYLES
Three-dimensional
Movement
Color Line
Symbols

EVALUATION- - - - - - - -Peers, self, teacher-student, etc.

The Inquiry Process should help the student as follows: to be persistent in learning; to look for objectivity, reason, and logic; and to remain open-minded until evidence is in. Learning to use this thought process opens the world to the student for independent study. The teacher can become a facilitator instead of a "giver of knowledge."

THINKING OPERATIONS

Teaching for Thinking: Theory and Application. Louis Raths, Selma Wasserman
Arthur Jonas, Arnold Rothstein. Merrill Publishers, 1967.

THINKING OPERATIONS - The ten operations are not exclusive nor sacred.

1. Reacting to coding - "The teacher can help the student 'see what he thought' by getting him to look at what he wrote." Coding the students' writing to indicate his type of thinking may help him to think more logically. Examples of types of statements, extreme statements, generalities, qualifications, either-or's, analogies, if-then's, value statements, superfluous words. (p. 121)

2. Comparing - discerning likenesses and differences. More opportunities for comparison form a basis for judgment. Teachers might select two items and ask for comparisons based on different criteria. (p. 132)

3. Classifying - an extension of comparing - Enough similarities lead to grouping; the taxonomic process is based on classifying. Classifying may use established groups or may be open-ended for students to establish their own groups.

4. Observing and reporting - sense impressions as basis--should be checked for accuracy. "Inaccurate sense evidence leads to misinterpretation and false inference." This type thinking would involve memory and perception. (p. 164)

5. Summarizing - This type of thinking requires ability to discern and to evaluate what is significant and what is insignificant. Main ideas are brought together in a synthesis. It is useful to have students compare summaries, defend their omissions or inclusions, and understand the differences. (p. 174)

6. Interpreting - This thinking operation "is concerned with the inferences and generalizations which may be drawn from reports." It involves understanding to the point of adding meaning within the limits of the material. (p. 181)

7. Analyzing Assumptions - Assumptions are the unwritten rules upon which a culture of society operates, understood by those within that society. Students should be helped to distinguish between fact and assumption. "To look for assumptions is to look for what is not stated but must be believed if that which is stated is to be accepted and believed." (p. 196)

8. Problem-Solving - The authors use this term to mean working on questions to which answers are not known, acquiring the skills of expressing what it is they do not know. Problem-solving involves high levels of techniques such as deductive, interpretive, observational, or statistical. The authors include decision-making and hypothesizing in this discussion of problem-solving. (p. 208)

9. Criticizing and evaluating - Students are given opportunity to take a position and defend it, justify it. This process involves setting a standard and judging. (p. 220)

10. Imagining and creating - This operation applies to thinking as well as the areas of the arts. A different approach to a problem, inventing new principles, new rules are ways to use the operation. Allowing and encouraging students to ideate, to create, to change old ways, to invent new ways will offer opportunity to improve this type thinking. (p. 231)

INTRODUCTION TO THE SCIENCE UNITS

Five science units are included in this handbook in a suggested teaching order, as follows:

1. Sound
2. Light
3. Magnetism and Electricity
4. Weather
5. Plants (best for spring)

Each unit, with the exception of Sound, is presented in two parts:

1. Teacher plans and strategies
2. Student guidebook

Teacher plans are incorporated within the Sound Student Guidebook.

A general bibliography of sources can be found after the science units. Many other resources can and should be located by the teacher and students. The student guidebook contains activities and thinking processes. All activities are based on the learning cited in an earlier section.

A teacher may use the student guidebook in a number of ways. All questions need not be completed by all students. A teacher may assign or have students choose activities or questions from all or only certain topic areas. A student may benefit more from the assignments if he/she is encouraged to give oral presentations to the class. Most questions require the student to read and learn and then apply the acquired knowledge to some project. Therefore, a variety of responses may be acceptable. It is also advantageous to use audio-visual materials, guest speakers, and field trips whenever possible. Reinforce the students' efforts by encouraging them to share their feelings and hunches, etc. in addition to demonstrating and displaying their guidebook activities.

Sound

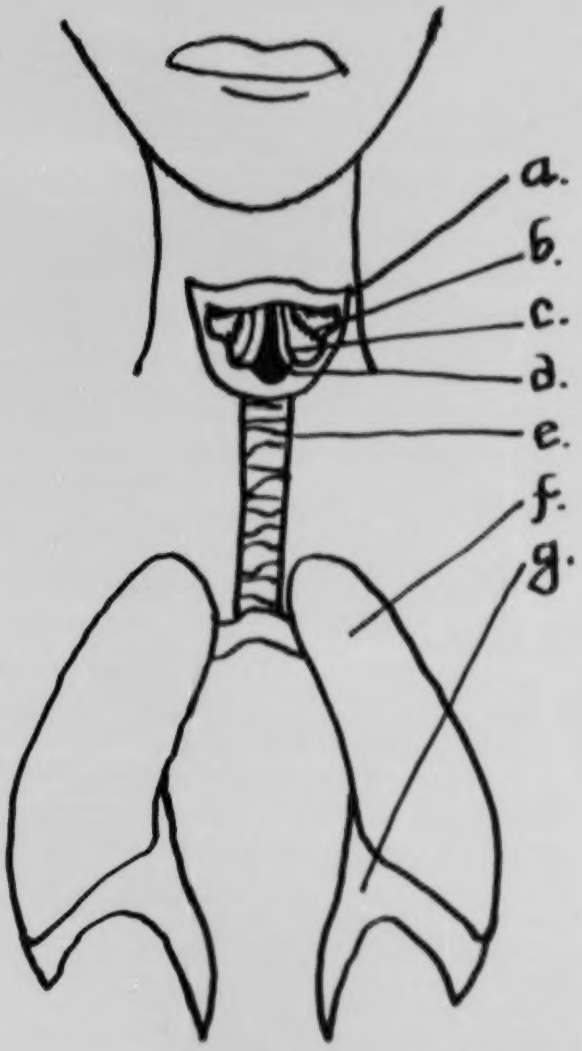
BULLETIN BOARD IDEA #1

CHARACTERISTICS OF SOUND

PITCH	INTENSITY	QUALITY
high	loud	fundamental tones
low	soft	overtones

BULLETIN BOARD IDEA #2

HOW MANY CAN YOU IDENTIFY?



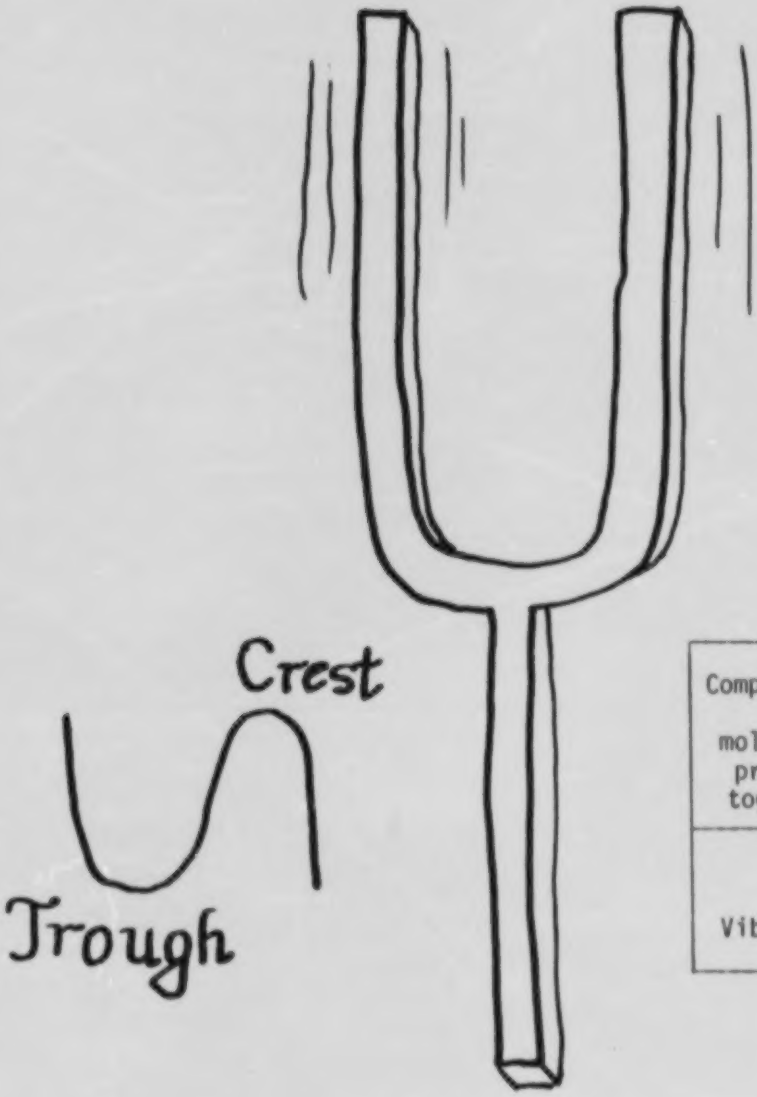
DIRECTIONS:

diaphragm
larynx
muscle
vocal folds
lungs
trachea
glottis

1. On your paper, match these parts within the throat and chest with the labels.
2. Give a second name for three of the labels.
3. Describe each part and tell its purpose.

BULLETIN BOARD IDEA #3

HOW SOUND TRAVELS



Compression	Rarefaction
molecules pressed together	molecules spread out
One complete Vibration or Sound Wave	

STUDENT GUIDEBOOK

SOUND

I. How Sound Is Produced

A. Experiments

1. Prepare a floor plan of your home. Write the name of each object producing sounds in each room. You may even tape record noises and have a guessing game to identify the sounds. Discuss types of sounds and most common sounds heard.

2. Materials needed: rubber band, tuning fork, tissue paper, comb

a. Hold one end of a rubber band in your teeth and stretch the band. Pluck the band in the middle. What happens?

____

____

____

b. Strike one prong of a tuning fork sharply against your kneecap or the rubber heel of your shoe. (Never strike a tuning fork against a hard object.) Hold one end of a sheet of paper and touch one prong lightly to the other end of the paper. What happens? ______________________________

____

____

c. Place tissue paper against the teeth of a comb and hum a tune. What happens?

____

3. Materials needed: 12-inch wooden ruler
While holding one end of the ruler on the edge of the desk, press down hard on the free end about 8 or 10 inches extending over the edge, and then suddenly let go. What happens? ____________

____

B. Thinking Processes

1. Combining your observations from each experiment, did the same things happen? What?

____

____

____

2. Compare what is taking place in a state of sound and a state of no sound. ______________________________

____

____

3. Write a cinquain about sound:

   Line 1: one word subject
   Line 2: an observation about Line 1
   Line 3: a feeling about Line 1
   Line 4: another observation about Line 1
   Line 5: a one word synonym for Line 1

   Select a particular sound or object that produces sound to write about. Read your syntus to the class. You also need to illustrate it.

II. How Sound Travels

A. Experiments

1. Material needed: Slinky
   Stretch the Slinky across the floor. Hold one end while a classmate holds the other. Quickly push your end of the Slinky in the direction of your classmate, then pull in back to its original position. How did the Slinky move when you pushed and pulled it?

   ____

   ____

2. Materials needed: tuning fork, jar of water

   a. Place a student in the center of the room and one in each of the four corners. The student in the center will talk. Where can the noise be heard?

      ____

   b. Strike the prongs of a tuning fork very sharply against your kneecap or rubber heel of your shoe. Quickly place the ends of the prongs in the center of the jar of water. What happens?

      ____

   c. Have several tuning forks. Strike them one at a time. Which one has a higher sound?

      ____

      Rank order the tuning forks. Who has the highest sounding tuning fork? The lowest?

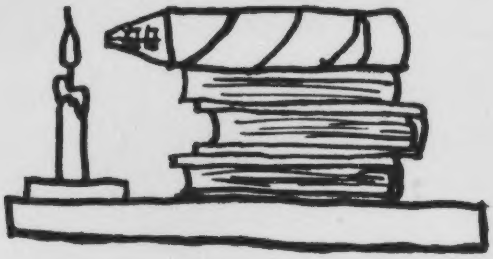
      ____

3. Materials needed: cardboard tube from paper towels, small sheet of paper, tape, candle in candlestick, a few books, a balloon

   Roll the small piece of paper into a cone and fasten it with tape. The base of this cone should not be much wider than the diameter of the tube. Fasten the cone to one end of the tube by means of tape. Now cut off the tip of the cone so that you leave a hole a little more than ¼ inch wide. Cut the balloon and cover the other end of the tube. The rubber should be stretched tightly over the end of the tube. Keep the rubber in place with tape. Light the candle and put it on a table. Using the books, prop the tube in position as the illustration below shows so that the hole in the cone points directly at the candle flame. Be careful not to set the paper on fire though! Now clap your hands together sharply just behind the rubber end of the tube. (See figure below.) What happens? ____

____

____



4. Materials needed: tuning fork, piece of thin wire or bristle from a brush, glue, pane of window glass, candle, ruler, several books

   Clamp the tuning fork firmly to an upright support so that the prongs are horizontal. Glue the thin wire or brush bristle to the upper surface of one prong so it projects outward and downward from the end of the prong. Now hold the pane of glass carefully over the candle flame until the lower surface of the glass is covered with soot. When the smoked glass has cooled, place it on the books so that the tip of the wire of bristle rests lightly on the sooty surface. Place the ruler next to the books as a straight line guide. Draw the books along the table straight toward yourself so that the wire traces a line in the soot. If you have pulled the books in a straight line, the line in the soot will be straight. Carefully lift the tip of the wire just a fraction of an inch off the glass and push the books back to their original position. Release the tip of the wire so that it is now resting on the beginning of the line we have traced. Now strike the tuning fork a horizontal blow with a pencil, and again pull the books straight toward you. This time the tip of the wire traces a wavy line in the soot. What is happening?

   ____

   ____

   ____

B. Thinking Processes

1. How does the Slinky move like the bristle?

   ____

   ____

   ____

2. Compare the action of the Slinky to the autograph of sound.

3. Create your own theory about how sound travels.

4. After class discussion, evaluate your answer in number 3. On a scale of 1 - 10, how close were you to the correct theory?

5. Challenge: Answer these and demonstrate to the class:

   a. What is the crest of a wave? the trough?

   b. What is meant by wavelength?

   c. How is wavelength measured?

6. Write a one-page biography: "My Life as a Tuning Fork"

III. Sound Travels Through Solids, Liquids, and Gases

A. Experiments

1. Material needed: 50-foot garden hose

   Send one child out of the room with one end of the garden hose. Have another child speak very softly into the hose. What happens?

2. Materials needed: Gallon glass jar, water

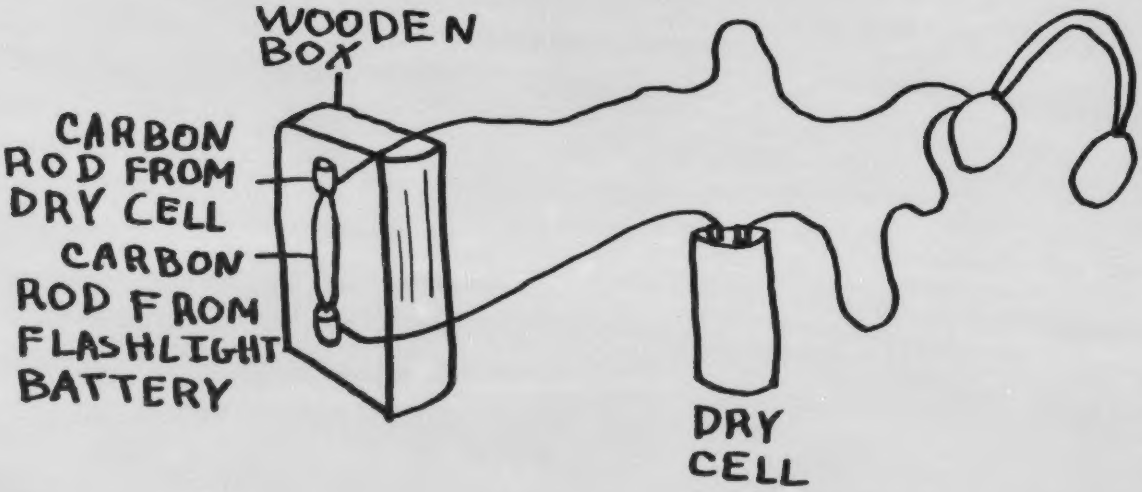
   Fill the jar almost full of water. Pound two rocks together about 6 to 8 inches from a child's ear. Now have that child place his ear against one side of the jar. Pound the rocks together again under the water. What is the difference?

3. Stand at one end of a table and have a classmate stand at the other end. Scratch the table top so lightly with your fingernail that the child cannot hear the sound. Now have the child place one ear against the end of the table, and then scratch the table again. What is the difference? Why? ______________ ____

4. Make a real Telephone: (Optional)
   Materials: carbon rod from the center of a dead No. 6 day cell; carbon rod from the center of a flashlight "D" cell; a cigar box, preferably wooden, or other small wooden box; 100 feet of bell wire; an old telephone receiver or a headphone set

   Saw off two 1-inch lengths of the carbon rod from the dead dry cell, and grind out a small hollow in the end of each piece. With sandpaper, sharpen the ends of the rod from the flashlight battery. Affix the two hollowed-out pieces of carbon to the back of the cigar box, using wire in the manner shown below. The sharpened carbon rod should be placed between the two pieces of carbon, so that its points touch the hollowed-out place in each. Cut the 100 feet of wire in half and then cut one of the halves in half. You now have three pieces of wire: one is 50 feet long and two are each 25 feet long. Fasten one end of each 25-foot wire to one of the headphone wires. Fasten one end of each 25-foot piece of wire to the live dry cell. Then attach the remaining ends to the hollowed-out carbon and to the remaining wire of the headphone.

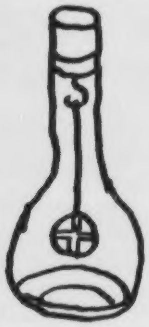
   Your telephone is complete. If someone talks into the front of the cigar box, the movement of the sharpened carbon rod will vary the amount of electric current in the wires, and diaphragm of the receiver will vibrate to produce the same sound waves as those of the person speaking into the box. (See figure below.)



5. Materials needed: large Pyrex flask, solid rubber stopper, small hook, string, small jingle bell, water, hot plate

   Push a small hook into the underside of the stopper. From the hook suspend a string that is attached to a small jingle bell so that the bell will hang freely inside the flask when the stopper is inserted. Place a small amount of water in the flask, set the flask on a hot plate, and boil the water until almost all the air inside the flask has been driven off and there is mostly steam inside the flask. Remove the flask, insert the stopper, and allow the flask to cool. The steam will condense, leaving a partial vacuum in the flask.

   Set up a second (control) flask exactly like the first, but do not boil the water so that this second flask is full of air. Now shake both flasks gently. Compare the loudness of the bell in each. (See figure below.) Which is louder? Why?



6. Research these questions about Robert Boyle:

   a. When and where was he born?
   b. What was his training in science?
   c. What discoveries did he make?
   d. What made Boyle creative?
   e. What might have happened later in his life?

7. Research these questions:

   a. Who invented the telegraph?
   b. When was the telegraph invented?
   c. How does the telegraph operate?
   d. What is the Morse Code?
   e. Why did he invent the telegraph?
   f. What might have happened later in his life?

B. Thinking Processes

1. a. Rate these seven experiments from simplest to complex in your ability to perform them.

   b. What did you base your ratings on?

2. Rank in the order of highest to lowest which media conduct sound best.

3. Determine the cause of one medium conducting sound better than others.

4. Can you discover how the telephone experiment works? Explain in your own words.

5. After class discussion, evaluate your answers in numbers 2 and 3. On a scale of 1 - 10, how close were your answers to the correct theory?

____

____

IV. Characteristics of Sound

A. Experiments: Pitch

1. Materials needed: Index card, comb

   Draw the edge of an index card over the teeth of a comb at different speeds. What is the difference in sound? ______________

   ____

2. Materials needed: pencil, four rubber bands of different thicknesses, shoe box

   Stretch the rubber bands around the box in order from thinnest to thickest with about one inch between each rubber band. Number each band starting with the thinnest band. Start with band #1 and pluck each band once with the same amount of effort. Repeat and watch the bands closely as you pluck them. To try something different, hold the thickest band about 1 inch from the edge of the box and pluck it again. Describe the differences in the sounds you heard. ______________________________

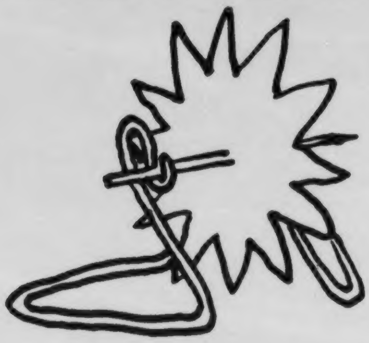
   ____

   ____

   ____

3. Use a pinwheel or make one:
   Materials needed: piece of cardboard at least 6 inches by 6 inches, drawing compass, scissors, one hexagonal (six-sided) pencil sharpened on one end, coat hanger, drinking straw or other thin tube, pliers

   Use the compass to draw a circle at least 6 inches in diameter on the piece of cardboard. Draw another circle with the same center but with a diameter 3 inches smaller than the first. The inner circle will then have its circumference 1½ inches from that of the larger circle. Cut the larger circle out of the cardboard. Now cut triangular notches that reach from the outer edge of the circle to the inner circle. This will produce 1½-inch teeth all around the inner circle. Slowly push the point of the pencil through the center of the cardboard disk, until about half the pencil projects on each side. Make a stand from the coat hanger wire, using the pliers to bend the wire. Place the pencil and cardboard disk on the stand, as the illustration on the next page shows. Spin the disk with one hand, while blowing air from the straw at the teeth on the disk. What is the difference in the sound produced by different speeds of the disk? (See figure below.)



4. Materials needed: two identical water glasses, water, pencil

Fill one glass about half full. Strike the glass lightly with a pencil and listen carefully to its pitch. Put a little water in the other glass, strike it with the pencil and listen to its pitch. By adding water slowly to the second glass, try to have it sound the same pitch as the first glass. How easy was it to match the same pitch? How could this principle apply to musical instruments?

B. Thinking Processes

1. Discuss the similarities or differences you heard in these experiments.

2. Write what frequency means as it applies to sound.

3. Compiling your answers for the first two questions, construct your own theory of the cause of this type of sound contrast.

4. Design another way to create this type of sound.

____

____

____

C. Experiments: Intensity

1. Repeat Experiment I.A.2. This time vary the strength you use to produce sounds. What difference can you hear?

____

____

____

2. Material needed: one plastic ruler

Place your ruler on your desk with about six inches sticking out over the edge. With one hand, hold down the end of the ruler on your desk. With the other hand gently push down on the free end and let go. Watch the ruler's movement. Listen to the sound. Repeat this action except push down harder on the free end of the ruler. Try it again varying the amount of ruler that sticks out over the edge of your desk. Under which circumstances did the ruler vibrate more? How was the sound different?

____

____

____

____

3. Materials needed: record or tape of instrumental music, large sheets of drawing paper for all classmates, crayons

   a. Tell the students to sit quietly and listen to the recording. (Play it low.) NO TALKING!

   b. Tell the students to select a crayon and draw how it makes them feel. (3 minutes)

   c. Stop the recording and have the students put their crayons down.

   d. Play the recording again increasing the speed. Repeat step b. (3 minutes)

   e. Compare drawings and discuss feelings during the recording.

Write how you felt and how you think your drawing turned out, (honestly). Write on the back of this page.

D. Thinking Processes

1. Discuss the similarities or differences you heard among the experiments. ____

   ____

   ____

2. Form your own theory of the cause of this type of sound contrast.

   ____

   ____

   ____

3. How do you think this type of sound contrast could be measured?

   ____

   ____

   ____

4. How did Experiment 3 make you feel? Did this activity generate any ideas to help you answer question 2?

   ____

   ____

   ____

   ____

   ____

5. Develop another way to create this type of sound contrast.

   ____

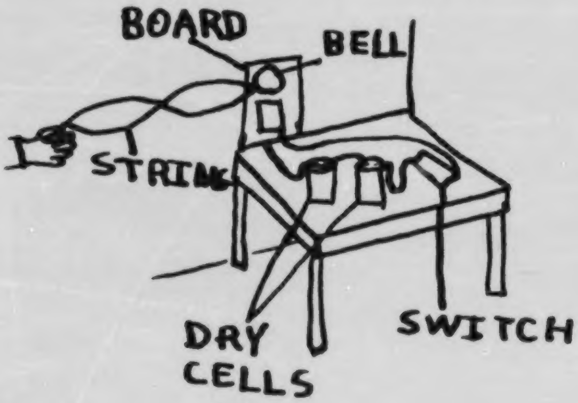
   ____

   ____

E. Experiments: Quality

1. Materials needed: electric bell, piece of wood, two dry cells, switch, string, wire

   Push a table against the wall. Attach an electric bulb to a piece of wood and bend the clapper of the bell so that it will not strike the gong when it is moving back and forth. Connect the bell to two dry cells and a switch as shown in the illustration on the next page. Obtain about 10 feet of thin, soft string and attach one end of the string to the clapper. Push down the switch to complete the electric circuit and set the clapper moving back and forth. Stand some distance away and pull on the string as the clapper vibrates. By experimenting with the amount of pull on the string, you will be able to make the string vibrate as a whole to form just one loop, and then vibrate in parts to form two, three, or even four loops. Compare this formation of loops with the formation of the fundamental tone and overtones in vibrating objects to produce sounds. (See figure below.) What characteristic of sound do you think this experiment demonstrates?



2. Questions:

   a. Describe the type of sounds you heard.

   b. Compare these sounds you heard with those you have heard in another experiment. Tell which experiment you are comparing with and why.

EXPERIMENT	TYPE OF SOUND	WHY I COMPARED

c. Construct another means by which you might produce different overtones. ______________________________

____

____

d. Consider the theory of sound quality and explain why your "Overtone Producing Method" will work. ______________

____

____

____

e. Try out your method.

F. Thinking Processes

1. Which characteristic of sound do you think would most affect a(n):

   a. factory worker
   b. rock musician
   c. airplane mechanic
   d. orchestra musician

____

____

____

____

____

2. Find and cut out pictures from magazines that depict different characteristics of sound (loud or soft, high or low, etc.) Create a short story or poem describing the sound being produced in your picture. Do this activity on another piece of paper.

3. Explain how you felt while doing your experiment concerning a characteristic of sound.

____

____

____

____

4. Were there any experiments you felt "uneasy" about while you or another student was performing it? Explain how you felt and why.

____

____

____

____

V. Echoes

A. Experiments

1. Research echoes

2. Define: reflect

____

absorb

____

3. The class will go to the auditorium and the gymnasium when empty. We will stand at one end and produce echoes. Can these echoes be heard when the auditorium is filled? How can echoes be eliminated? ______________________________

____

____

B. Thinking Processes

1. Relate 5 - 10 different places where echoes can be heard if you yell. Which class member came up with the most places?

____

____

2. On a large piece of paper draw the floor plan of your classroom (regular class). Locate all windows, furniture, doors, curtains, rugs, etc. Imagine that you would be allowed to redesign the room to minimize sound. You have an unlimited expense account. Draw your new classroom and write a paragraph about your changes and why you made them.

3. Ocean depth is often determined by an echo sounder. Sound emitted from a ship hits the ocean bottom and is reflected to the ship. The time it takes for the sound to travel from the ship to ocean bottom and back to the ship is divided in half. This gives the time it took the sound to reach the bottom before being reflected. Using the formula: Distance = Speed X Time, and knowing the speed of sound in water (1463 Miles/second) (4760 feet/second), the distance to the ocean bottom can be computed. Solve these problems:

   a. It took 4 seconds for a sound to return to a ship. How deep is the ocean bottom where the sound hit?

   ____

   b. It took 10 seconds for a sound to return to a ship. How deep is the ocean at that point?

   ____

VI. The Voice

A. Experiments

1. Feel your windpipe while you are humming or making low sounds. You will feel your vocal cords vibrating. Make loud and soft sounds, noting the greater force with which air is blown between the vocal cords to produce louder sounds. Say something in your normal voice, and then repeat it while pinching your nostrils shut. What changes do you notice in each change made?

   ____
   ____
   ____
   ____

2. Inflate a balloon and allow the air to escape while you pinch and stretch both sides of the neck of the balloon. The more you pinch and stretch the rubber, the higher the sound becomes. Compare this effect with the tightening of the vocal cords to produce higher sounds. Discuss the difference in length and thickness of men's and women's vocal cords, and the effect on the pitch of the sounds produced.

   ____
   ____
   ____
   ____

B. Thinking Processes

1. Brainstorm words to describe the voice.

   ____
   ____

2. Do emotions affect your voice? How?

   ____
   ____
   ____
   ____

3. Questions:

   a. Guess what is actually happening in your windpipe as you are making the different sounds. ______________________

      ____
      ____

b. Compare your pinching the balloon neck to the way you make sounds. ____

____

____

c. How do the characteristics of sound affect the voice?

____

____

____

____

d. Three students will be chosen to act as judges to rate the class on the lowest to the highest pitched voices. Judges will rate voices on a scale of 1-10 (1 is the lowest pitch; 10 is the highest pitch). Each class member will make the lowest pitched voice he/she can. Then the highest pitched sound. The judges will then line up the students according to their ability to make a high pitched sound, a low pitched sound. The judges will create a chart to record their findings.

e. How did you feel about this experiment? Were you surprised?

____

____

____

f. Find out the meaning of these words in relation to singing voices: soprano, alto, tenor, bass. Name one or more famous singers for each type of voice. ____________________

____

____

____

g. Bring records to school to play and label the voices.

VII. The Ear

A. Experiment

The Ear Kit contains a Human Ear Model, a two-lesson cassette tape about construction and performance of the ear, activity sheets for the lesson, a test, and activity cards. We will follow the two-lesson program and use cards 7 and 8 about "Kinds of ears" and card 9 about "Sign Language."

B. Guest Speaker

Invite your speech and language specialist to speak.

C. Research

Be a Detective for one week! Identify the real names of these famous musicians who are all blind and depend solely on their ability to hear.

1. Mr. M
   - Born in American
2. Mr. C
   - Born in Georgia in 1932(?)
   - Plays piano, alto saxophone, and other instruments
   - Blues singer
3. Mr. F
   - Born in 1945
   - Raised in NYC
   - Plays guitar, banjo, harmonica, and other instruments
   - sings
4. Mr. W
   - Born in 1950
   - Raised in Detroit
   - Plays piano and other instruments
   - sings and composes
   - His name before he went into show business was Stevie Judkins

D. Thinking Processes

1. How are these men alike?

   ____

   ____

   How are they different?

   ____

   ____

2. Do you think these traits lead them to their creative productions? Why? ____

   ____

   ____

3. Compare the value of their creative productions as recognized by people today. (gold records, awards, etc.)

   ____

   ____

   ____

4. If you have any recordings of the above musicians, we will listen to them in class.

5. Take the Test from the Ear Kit. Record your score here.

   ____

6. Research air pressure. Draw a picture and show the state of the eardrum in each.

7. Describe (below) and demonstrate on the Human Ear Model what effect: (1) high altitude (mountains), (2) low altitude (sea level), and (3) below sea level (below the ocean) would have on your ear. What is the altitude where you live? __________

____

____

____

____

____

8. Have you ever had any type problem with your own ears? Describe exactly what the problem was and which parts of the ear were affected. Tell the class. ______________________________

____

____

____

____

____

9. Which part(s) of the ear do you consider most important for its effective functioning? Why? ______________________________

____

____

____

VIII. Music and Musical Instruments

A. Music Verses Noise; Thinking Processes

1. Make a list of unpleasant noises you have heard. Relate noise with irregular vibrations and music with regular vibrations. Draw diagrams of both regular and irregular vibrations. How do they affect how you feel? ______________________

____

____

B. Research the different instruments: string, percussion, wind

1. Stringed Instruments

   a. You may bring your own string instruments and demonstrate to the class how pitch can be altered.

   b. Contrast the different sounds produced by a guitar and classify three things that affect pitch. ____________

   ____

   ____

   ____

   c. List as many different stringed instruments as you can.

   ____

   ____

2. Wind Instruments

   a. Experiments

      (1) Materials needed: 8 soda bottles, water

      Line up the eight bottles. Pour different amounts of water in them, adding or taking away water as needed, until you have produced the eight notes of the scale when you blow across their mouths. What is the relationship between the length of the air column in each bottle and the pitch of the sound produced.

      (2) You may bring your own wind instrument to class and demonstrate how pitch is changed to produce music.

   b. Thinking Processes

      (1) List as many wind instruments as you can think of.

      ____

      ____

      ____

(2) Upon surveying the above exercise, analyze what causes the production of different sounds or pitch.

(3) Suppose you were a famous trumpet player, what would be the effect on your performance if you had a bad cold? What would be the effect is you had a bad infection in your semicircular canal?

3. Percussion Instruments

a. Experiments

(1) Materials needed: large balloon, three different size glass jars

Cut the balloon to form one large piece of rubber. Stretch it across the mouth of the smallest glass jar. Have another classmate strike the rubber repeatedly with the eraser part of a pencil. Try it with the other two glass jars. Describe the different sounds heard.

(2) Materials needed: raw rice, three different size tin cans

Invert the tin cans, placing some rice on each can. Firmly tap each can many times with a pencil. List to the sounds produced. What happens to the rice and why?

(3) You may bring your own percussion instrument to class to demonstrate how pitch is changed to produce music.

b. Thinking Processes

(1) List as many percussion instruments as you can think of. ____

____

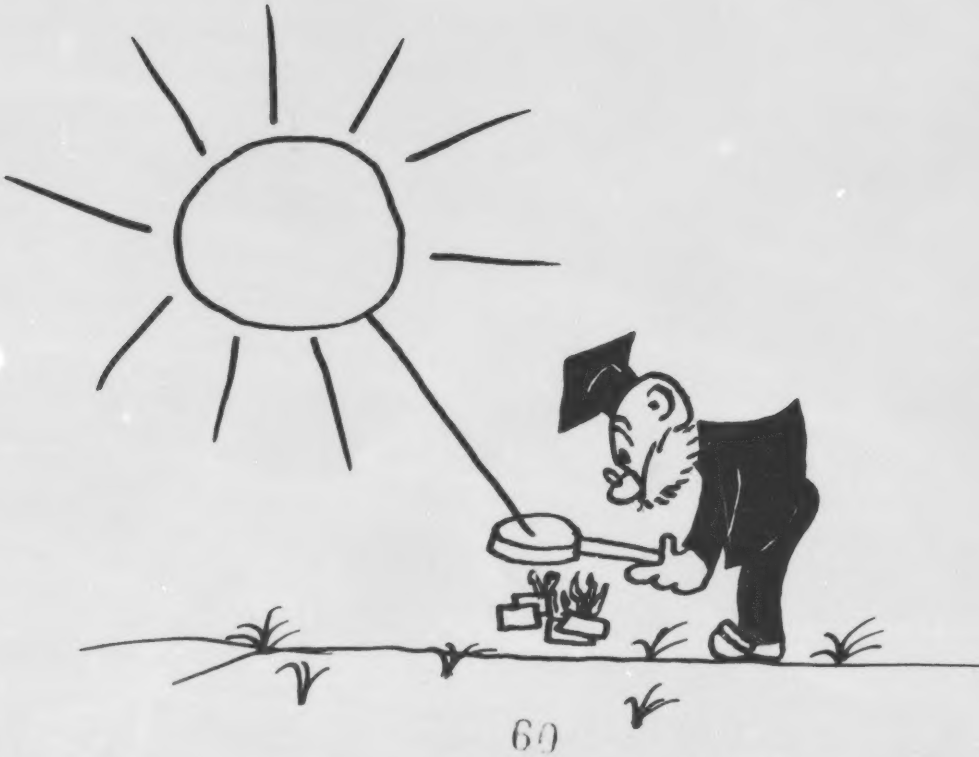
____

(2) Simplify the basic components that can vary to produce different pitch of sound. ____________________

____

____

Light



TEACHER PLANS AND STRATEGIES

LIGHT

Materials needed for unit: Film projector; flashlights; candles and holders; chalkboard erasers; rulers; transparent, translucent, and opaque articles (plastic wrap, tin foil, fabric, and wax paper); protractors; hand mirrors; quart milk cartons; two kaleidoscopes; glass square; pie pan; thin wire; magnifying lense (convex); prisms; 35 mm camera; magazines.

Suggested community resource people: Optometrists, photographer, x-ray technician.

This unit consists of ten lessons based on questions about the nature of light. A student may complete the guidebook and as an option, may design his/her own book on light. This unit requires that the student learn to take notes and collect and organize data, as well as to be creative in designing a book that will explain the ten questions to a younger reader. The last instruction on each of the ten questions directs a student to use the information acquired in the study of that question to design a newsprint page for his/her book. The student should assemble the book with an appropriate cover. The books may be displayed in the library.

I. Where does light come from?

Be familiar with luminous and non-luminous categorization.

II. What is light?

Discuss matter and energy; explore the differences.

III. How does light travel?

1. Light always travels in straight lines. One experiment that demonstrates this is to punch a hole in the same spot on three note cards. Prop the note cards up at intervals of several inches so the holes are juxtaposed. Shine a flashlight through the first hole. The light goes through all three holes. Now move the middle card so its hole is not juxtaposed. The light does not go through the third hole

4. Isaac Newton proposed that light travels in particles; Christian Huggens proposed waves; Max Planets proposed the combination of the two theories, or quantum theory. Discussion of the history of the theory of light can be found in Rainwater, Light and Color or Light and Vision, Life Science Library.

5. Let students devise ways to show the concept demonstrated in #1 that light travels in straight lines.

IV. How do we measure light?

1. Ask the students to hypothesize: How would you measure light?

2. Present facts about light traveling from the sun, stars (Rainwater, Light and Color).

5. Compute distance in miles from Big Dipper if light left there 68 years ago.

   3600 sec/hr
   86,400 sec/day
   31,536,000 sec/year
   2,144,448,000 sec in 68 years
   Multiply by 186,000 to get miles.

V. What does light go through?

1. Display samples of translucent, transparent and opaque materials, such as: waxed paper, newsprint, fabric, glass, cellophane, wood, books, frosted glass. Display light sources, such as: flashlight, candle, film projector.

   a. Ask students to work in pairs and take one of each sample and a light source. They are to note what happens when the source hits the sample. Discuss their findings.

   b. Write on board: transparent, translucent, opaque. Define.

   c. Assign each sample to one of these three categories. Brainstorm other examples of these categories.

VI. What are shadows?

1. Before student answers questions in booklet:

   a. Give examples of hand shadow tricks (Whole Cosmos)

   b. Turn film projector light on and let class practice hand shadows.

   c. Experiments:

      (1) How can you make a shadow larger? smaller?

      (2) Can you see a darker and a lighter part of the shadow?

      (3) Can you make a shadow so sharp it looks like it's been painted? (No)

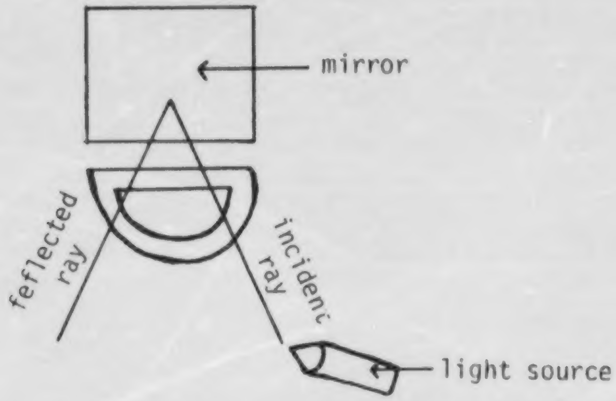
2. Answer questions in student book.

VII. What is the law of reflection?

1. Experiments:

   a. Use a light source, tin foil, hand mirror, dark paper, light paper. Shine the light on each surface. What happens?

b. Use a light source, hand mirrors, and a protractor. (You might mimeograph protractors for students to cut-out). Make light source very small, for example, by covering flashlight with black paper with a pencil hole in center. Working on a level surface, shine light on hand mirror. Lay protractor on table to measure angles of reflection.



Does reflected ray measure the same angle as the ray from the light source (incident ray)?

4. "Light is reflected or absorbed. Reflected light is either diffuse or specular. Light reflects at the same angle at which it hits a surface."

7. Make a periscope from a milk carton and a hand mirror.

8. Have two kaleidoscopes. Take one apart to demonstrate the use of reflection. Have students to examine both kaleidoscopes.

9. Optional activities

   a. Practice mirror writing. Research Leonardo da Vinci (National Geographic, September 1979).

   b. Be mirror images. In partners, work out a clown routine.

   c. Explore types of reflecting surfaces such as headlights or telescopes.

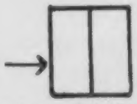
   d. Research history and use of mirrors.

VIII. What is the law of refraction?

1. Assign experiments to partners.

   a. Materials: pencil, glass, water
   Put pencil in glass of water. What do you observe?

   b. Materials: a square of glass, a piece of paper with a straight line on it.
   Lay half the glass on the paper so the line goes down the middle of the glass. What happens to the line when it meets the glass?



c. Materials: a pie pan, a penny, some water
Work in partners. Place a penny in the pie pan close to the edge nearest you. Step backwards until you can no longer see the penny. Have a partner pour water into the pie pan until you are able to see the penny.

2. Through discussion, arrive at a law of refraction:
Light is bent or refracted, when it travels from one medium to another. Light changes speed as it travels from one medium to another, depending on the density of the medium.

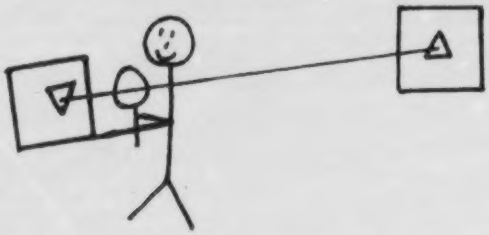
3. Make lenses
Pass out lengths of wire or paper covered garbage ties. Strip paper off ties. Bend one end into a circle and dip in water to make a lens. Use as a magnifying glass on print.

IX. How are the eye and the camera alike?

The eye:

Introduce the question, "How are the eye and the camera alike?"

1. Demonstrates the principle of an inverted image. You need white and colored paper and a convex lense. Tape a colorful paper pyramid to the window. Stand with your back to the window. Hold the lense over the white paper and reflect the image of the pyramid through the lense to the paper.



3. Use The Eye, model and tape side one or have students draw a human eye and label parts.

5. Research eye defects and corrective lenses. Most optometrists have printed materials or discarded lenses which you may request. Sets of partners could be assigned different topics to research and share.

6. Experiment with optical illusions.

a. Find out who is right-eyed and left-eyed.

b. Obtain and post a 3-D poster.

c. Find examples of optical illusions. (The Eye Kit, Nystrom; World, Nov. 1975 - Feb. 1978, October 1979.)

The camera:

Review the question, "How are the eye and the camera alike?"

1. Distribute printed illustrations of the eye and the camera, or (use bulletin board #2 as display material).

2. Ask students to discuss and decide what parts the eye and the camera have in common.

3. Have a 35-mm camera for students to examine or have a speaker present information about the history of film and/or operating a camera.

4. If possible process some photo-sensitive paper. Ask a local photographer for assistance.

X. What is color?

Introduce the question:

1-4 Duplicate Newton's experiment of reflecting sunlight from a mirror in a pan of water. See Appendix.
Discuss what students see. What order are the colors? How many colors? Where did the color come from? What do you think happened to the sunlight before it became the colors? Which might be the shortest and longest light waves?
Use prisms, if available, to make the spectrum. Discuss how water in air makes a rainbow.

5. Create bulletin board #3.
Have students work in teams to collect magazine pictures of the 7 colors of Newton's spectrum. Each team collects one color.
Have students make a half or whole circle on which they will paste the colors of the spectrum.

7. Have a scavenger hunt. Give students a list of color names (mauve, scarlet). Have them categorize the color names, using the spectrum as a guide. Use fashion ads and magazines to hunt for color names.

8. Differentiate between adding light and adding pigment.

   a. Primary colors for light are: red, green, blue. These added together make white light.

   b. Complementary colors for light are any 2 colors, that when added together, make white light, ex: red and blue = green.

   c. Experiment with squares of colored cellephone (from business supply store). Shine flashlights through colored squares so the light from all sources is reflected on a white surface.

9. Subtracting colored light.

   a. When three colors - red, yellow, and blue are combined, the mixture is black.

   b. Color we see in our clothes is the color that is reflected after other colors are absorbed.

   c. What has happened to the white light from the ceiling when it hits a blue shirt? a white one? a black one?

11. Research color-blindness. Borrow a telebinocular from the testing service of your school.

13. Define: invisible spectrum. Try to get discarded x-rays from a hospital or dentist.

16. Thinking-feeling projects.

   a. Discuss how colors make us feel.

   b. Take a survey of colors students are wearing; colors of kitchens, bedrooms.

   c. Sit in a circle and have each person tell what color the person to the right of them seems to be and why.

   d. Then tell what color each person thinks he/she is and why.

18. Proceed with note-taking and illustrations. Complete booklets, make a creative, original cover.

STUDENT GUIDEBOOK

WHERE DOES LIGHT COME FROM?

1. Brainstorm:
   Where does light come from?

2. Categorize your answers.
   Can you make 2 separate categories that will cover all your ideas?

3. Define
   luminous ________________________________

   non-luminous ____________________________

4. Make a list of luminous objects. Rank order them from brightest to dullest.

5. Plan, design, and write your own book. Make a book on light for a younger child to read.

   1. Collect information on each of 10 questions on light. Write important facts on note cards.

      Ex.

      > Where does light come from?
      > a. luminous sources
      > b.

   2. Plan and illustrate a page of newsprint that

      a. asks the question, "Where does light come from?"
      b. answers the question

WHAT IS LIGHT?

1. Define
   energy ____

   matter ____

2. Brainstorm kinds of each

3. What is light - energy or matter?
   Explain your answer.

4. Draw these: sun, fire, star.
   Now label the part of each that is energy and the part that is matter.

5. Design a page for your book.

HOW DOES LIGHT TRAVEL?

1. You need a film projector and 2 dusty chalkboard erasers. Darken the room. Turn on light of projector so it goes outside the room. Clap two erasers together in front of the projector.

2. Write your observations. ______________________________

____

____

3. Define ray: ______________________________

4. (Do research) Investigate the history of theories on how light travels. Complete this chart.

Name of Theory	Who Proposed	Main Idea
Particle		
Wave		
Quantum		

5. Devise an experiment to show how light travels. Use books on light from library. Demonstrate your experiment to the class.

   Materials:

   Experiment:

   Results:

6. Design page for your book.

HOW DO WE MEASURE LIGHT?

1. How would you measure light?

2. What is the speed of light?

3. Define

   footcandle

   light year

   parsec

4. Demonstrate 3 footcandles of light with a ruler and a candle.

5. Compute the distance in miles to the Big Dipper if light left there 68 years ago.

6. Why do we need units of measure like light years and parsecs?

7. Design a page for your book.

WHAT DOES LIGHT GO THROUGH?

1. Do assigned experiment.
2. Describe the experiment you did to show the laws of reflection.

   ____

   ____

   ____

3. Define

   transparent ______________________________

   translucent ______________________________

   opaque ______________________________

4. Write a poem about light and what it will go through.

5. Design a page for your book.

WHAT ARE SHADOWS?

1. Define

   shadow ____________________

   umbra ____________________

   penumbra ____________________

2. What hand shadows can you make?

   ____

   ____

3. Be a scientist. Explain the Groundhog's Day superstition in scientific terms.

   ____

   ____

   ____

   ____

4. Do research. Make a sun dial.

5. If you were a shadow, how would you keep up with your master? Write a story about it.

6. Design a page for your book.

WHAT IS THE LAW OF REFLECTION?

1. Do assigned experiment.

2. Define
   reflect ____
   absorb ____
   light ray ______________________________________
   angle ____

3. Describe the experiment you did to show the law of reflection. (See list of suggested experiments in teacher's notes.)

4. Write the law of reflection.

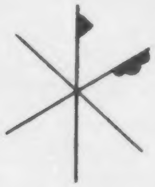
5. Working in groups, design your own mirror tricks. Share them with the class.

6. Why do we need mirrors?

7. Illustrate how a periscope works.

8. Describe how a kaleidoscope works.

8. Draw kaleidoscope pictures



9. Design a page for your book.

WHAT IS THE LAW OF REFRACTION?

1. Do assigned experiment.

2. Define
   refraction ________________________________
   lens ________________________________

3. Describe the experiment you did.

   ____
   ____
   ____
   ____

4. Make a lens.

5. Write the law of refraction.

   ____
   ____
   ____
   ____

6. Define
   concave ________________________________
   convex ________________________________

7. Draw what happens when a light ray hits:
   a. a concave lens
   b. a convex lens

8. Design a page for your book.

HOW ARE THE EYE AND THE CAMERA ALIKE?

A. Eye

1. Reflect an object through a convex lens onto a piece of paper. What did you observe?

   ____

2. Draw what happens when light rays from an image hit a lens and the image is reflected on a surface.

3. Do assignment for The Eye.

4. Design a bulletin board display to show parts of the eye.

5. List six kinds of eye defects and a brief description of each.

   a.

   b.

   c.

   d.

   e.

   f.

6. Define illusion ______________________________
   What is an optical illusion?

   ____

   ____

7. Design your own optical illusion.

8. Design a page for your book.

B. Camera

1. Draw what happens when light from an image hits a camera lens and reflects on film.

2. Brainstorm: What parts do the eye and the camera have in common?

EYE	CAMERA

3. Research the history of photography.

   a. What different materials have been used for recording images since the camera was invented?

3. b. List some creative people who were outstanding photographers.

NAME	DATES	KINDS OF PICTURES
1.		
2.		
3.		
4.		

4. If you could spend your spare time taking photographs, what would your favorite subject be? Why?

____

____

____

5. Brainstorm some personal qualities a successful photographer must have.

____

____

____

6. Design a page for your book.

WHAT IS COLOR?

1. Describe Newton's experiment.

2. Describe the 2 laws of light at work in Newton's experiment.

3. Describe what is happening, scientifically, when you see a rainbow.

4. Define

   spectrum

   prism

5. Draw and label the spectrum Newton described.

6. Hypothesize how Newton might have felt in seeing the spectrum. Compare these hypothesized feelings with your own impressions.

7. Start collecting and listing color names. (Read clothing ads in newspapers and magazines.) Where might you find color names used to describe objects?

8. What are the primary colors of light (not pigment)?

Illustrate the primary colors making white light.

9. Illustrate and explain how seeing a red shirt is "color by subtraction."

10. Why is the sky blue?

11. Research color blindness.

12. Hypothesize what the visible spectrum might be?

13. Illustrate the spectrum, both visible and invisible.

14. Which color or part has the shortest wave length?

____

the longest? ________________________________

15. List some invisible parts of the spectrum and ways people use them.

INVISIBLE PARTS	USES

16. How does color affect our feelings?
    a. What is your favorite color and why?

    ____

    ____

    b. What color best describes your best friend? Why?

    ____

    ____

    C. Invent a new color. Name it, describe it.

    Create a product that is this color and design an advertisement for display in a newspaper.

17. Design a page for your book.

18. Design a creative original and authentic cover for your book. Assemble your book.

Magnetism & Electricity

ELECTRICITY AND MAGNETISM

PLANS AND STRATEGIES FOR THE TEACHER

In this unit each lesson begins with a classroom activity. The teacher should explain what is required in each experiment; but she should let the students make observations, collect and classify data, and attempt an hypothesis on their own. During this activity, the teacher may act as a resource to develop critical thinking skills and proper research technique.

Following the activity, the students will need guidance in applying the knowledge gathered. The teacher should use some of the thinking operations as described by Raths and Wassermann as an outline to form questions or directions for the students. For example:

Compare a magnet with a battery.
Classify types of lightbulbs.
Interpret "peak load."
Criticize nuclear power plants.
Hypothesize a new use for a powerful magnet.
Apply facts and principals in new situations.
Make a decision.
Design a product.

These thinking skills relate directly to the areas of application, analysis, and synthesis in Bloom's Taxonomy. The teacher may use the questions, but she should not feel limited to these. Not only will the students need guidance in developing their thinking skills; they will require teacher assistance in locating adequate resource material. The teacher should accumulate many of the following references:

Science textbooks of any grade level.
Science magazines such as Discover, Science and Children, World.
Library books.
Booklets from state or federal agencies.
Pamphlets from related industries.
A complete encyclopedia sets.
A science encyclopedia.
Activity cards for science experiments

For the creative activities listed, the teacher needs to keep Williams' Model in mind. Both the cognitive and the affective areas of creativity require encouragement and challenge by the teacher. Creative reading, listening, writing, and visualization skills can be developed through science lessons. The teacher can use the suggested activities or elaborate on them, adapting them to student level or special interests. Students may be encouraged to develop activities as part of their classroom participation.

TEACHER NOTES ON LESSONS

MAGNETISM

1. Materials needed: tin can, glass, pencil, nickel, chalk, aluminum foil, coat hanger, penny, rock, brass fastener, paper clip, dime, thumb tack, rubber band, magnet, a steel object such as a needle.

2. Suggestions: After the students have tested the magnetism of the objects listed, ask them to group them in as many categories as they can. List these categories on the board. (For example: use, color, weight, material.)

   Encourage student research on magnets before trying to answer questions 3, 4, or 5. This will build students' self-confidence and encourage them to share knowledge and apply it to new situations.

MATERIALS THAT MAGNETIC FORCE CAN PASS THROUGH

1. Materials needed: a piece of paper, cardboard, ¼" plywood, 2" block of wood, plastic, aluminum foil, glass, tin can, copper, steel, a paper cup of water, a strong magnet, and a steel object such as a paper clip.

2. Suggestions: Before distribution of the materials, direct the students to predict which materials will allow the magnetic force to pass through to the steel object. This will encourage evaluation, decision-making, and some risk-taking. In analyzing the results, the students may need guidance in interpretation. (For example: conside the thickness of material or the strength of the magnet.)

THE LAW OF MAGNETIC ATTRACTION

1. Materials needed: two bar magnets, thread

2. Suggestions: Tie one end of a piece of thread securely around the mid point of one bar magnet. Direct one student to suspend the magnet by the thread, holding it steady until the magnet stops rotating. Another student should then touch another bar magnet to the end as illustrated and note the result as being either attracted or repelled.

   To write a law relating to this, the student needs to be reminded of his observations and to interpret them. The teacher might want to read some other scientific laws such as Sir Isaac Newton's three laws of motion:

   > "A body at rest tends to remain at rest, and a body in motion tends to remain in motion at a constant speed in a straight line unless acted upon by an outside force."

   Before students design their inventions, the teacher should lead the students in a brain-storming session to propose a variety of categories in which magnets might be used. This will encourage original thinking and imagination.

MAGNETIC FIELDS

1. Materials needed: Two bar magnets, a horseshoe magnet, clear sheet of plastic, iron filings.

2. Suggestions: Direct the students to sprinkle the iron filings over the entire sheet as evenly as possible; tap very gently to develop a visible pattern. Before students can answer activity #5, someone will need to research temporary and permanent magnets and report to the class.

EARTH AS A MAGNET

1. Materials needed: a bar magnet, thread, piece of styrofoam, needle, glass container, water.

2. Suggestions: When suspending the bar magnet, be sure it is not near metal which will affect the results. It may be necessary to tape the thread on the magnet so it will hang in a horizontal position. Have the students follow the directions in lesson one for magnetizing the needle for the boat. A few drops of detergent may be added to the water to allow the boat to float freely in the center of the container of water rather than being attracted to the sides.

   The teacher might encourage creative activities such as imagining how this force might affect various activities around the world. The research on the poles could be developed into a play or a choral reading.

COMPASSES

1. Materials needed: two compasses

2. Suggestions: The students must hold the compasses absolutely flat, or the needle will not rotate freely which would cause it to give an incorrect degree reading. Have the students practice activity #2 until they become competant in reading the compass and facing degree readings.

   In setting up a compass course, direct the students to sight along the compass needle to identify a distant object to walk toward. They also need to practice uniform steps of approximately 18 inches.

   For the Compass Treasure Hunt, two of the students could be encouraged to develop directions of equal difficulty and length but completely separate from each other until the final destination. These should be checked by the teacher for accuracy before the students attempt the courses. A good "treasure" might be a bag of candy to be shared by all.

STATIC ELECTRICITY

1. Materials needed: hard comb, bits of paper, chalk dust, balloon, salt, pepper, two plastic sheets, sawdust, iron filings, piece of paper.

2. Suggestions: After the students have observed the reactions of the various objects, ask them to use their imaginations, and think of a creative name for the force that caused the reaction. After they try to interpret the results, have students do experiment four. Direct them to compare this with the comb experiment. How is it alike? How is it different?

ELECTRIC STORMS

1. Materials needed: reference books.

2. Suggestions: Assign the students various subtopics to research on lighting: ancient beliefs, cloud formation, physical properties of a lighting stroke, damage, benefits, protectors, safety rules.

ELECTRIC CURRENTS

1. Materials needed: dry cell (battery), insulated wire, small light bulb and socket, steel knife, aluminum foil, glass, key, pencil, rubber band, plastic spoon, notebook, dime.

2. Suggestions: Have more than one light bulb in case one is defective or burns out. The dry cell should have no more than 1½ volts capacity, and should be fairly new or re-charged so that experiment #1b will work correctly.

   In making the survey for insulation, the students might walk through the school or immediate neighborhood, visit an electric company, or simply check their own homes.

ELECTROMAGNETS

1. Materials needed: two dry cells, insulated wire, two iron nails, paper clips, pencil.

2. Suggestions: After the students try experiment #2, the teacher might help them design a bar graph to illustrate the results. This is a form of applying facts and principles in new situations. In part 4 the students may need to research different areas where electromagnets are used and discuss why each particular usage needs a magnet that can be "turned off." (Start with a simple bell or buzzer.) This activity will lead directly into the brainstorming activity. Be sure to allow time for students to get beyond the obvious.

OPEN AND CLOSED CIRCUITS

1. Materials needed: dry cell, insulated wire, bulb and socket, knife switch.

2. Suggestions: In making an inventory of switches, it would be helpful to the students if a collection of these could be assembled in the classroom so the students can share discoveries with one another. Small electrical appliances or light fixtures are a good source for these.

The Morse Code may be sent with a light bulb instead of a buzzer, but this requires the receiver to study the bulb as well as the written code. It is easier for the receiver to translate the message if he can hear the signals while studying the written code.

SERIES AND PARALLEL CIRCUITS

1. Materials needed: dry cell, insulated wire, three bulbs and sockets.

2. Suggestions: Be sure that all connections are secure in each circuit. Conduct a general discussion on actual usage of the two types of circuits in the home or community. This application of learned knowledge will make the lesson more practical to the students than just learning the theory.

   In part 5 the class may be divided into discussion groups after each student has listed his own choices. Have each group tabulate members' choices and make a new group list. Then have each group report choices and combine these into a classroom list of priorities. This is a good exercise in evaluation, decision-making, and leadership.

DISCOVERERS OF ELECTRICITY

1. Materials needed: reference books on electricity and men who discovered uses for it; magazines and catalogs for the murals.

2. Suggestions: Each student should research a different scientist or inventor. Using these facts and principles, the students could act out each discovery for the class. The students should evaluate which they think were more important in the development of electrical usage.

SOURCES OF ELECTRICITY

1. Materials needed: Resource material for power plants and the lines of power distribution.

2. Suggestions: Before trying to draw the wiring from the lamp to the dam, the students will need to understand generators, transmission lines, transformers, and circuit breakers. If they have difficulty visualizing these, the teacher might supervise a drawing of the lines on a chalkboard by various students.

   A field trip to a power plant would help the students understand power distribution.

USES OF ELECTRICITY

1. Materials needed: lamp, doorbell, portable mixer, fan, TV, blow dryer.

2. Suggestions: In the observation of the various electrical appliances, help the students to compare and classify results. In analyzing this, they should have noted heat, light, sound, and mechanical motion.

   Understanding the "peak load" will involve interpretation and analysis by the students. One student might research this and report to the class.

ELECTRICITY MEASUREMENTS

1. Materials needed: a working electric meter, rulers to make a bar graph.

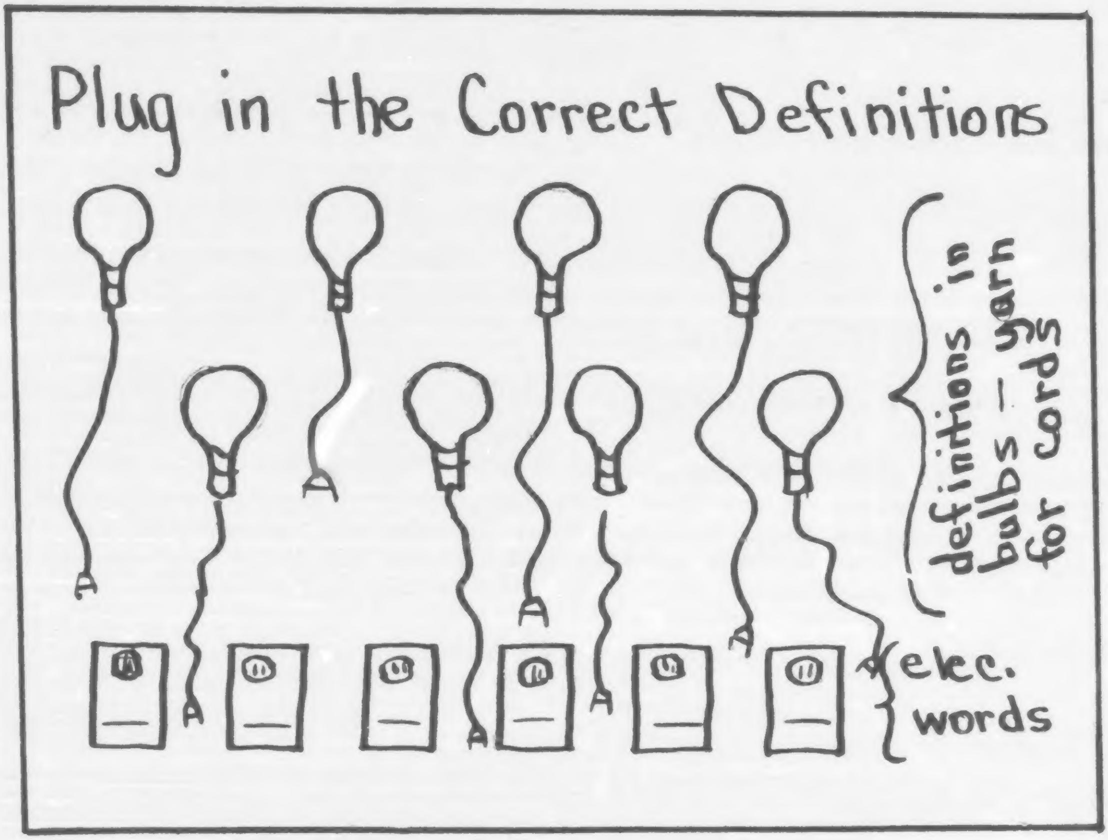
2. Suggestions: Activity #1 can be extended to a week or a month of checking the electric meter. Comparison can be made on times of high and low demands.

   In making the bar graphs the students first need to make a list of all light bulbs and their wattage grouped into household rooms where found. In applying these facts to a bar graph, they need a vertical section for each room in their house and may need to go above 700 watts total.

EDISON BOOKLET

1. Materials needed: white paper, large drawing paper, United States maps, rulers, crayons or markers, reference materials about Thomas Edison.

2. Suggestions: This booklet can be an on-going project during the unit on electricity. The teacher will need to explain how to read electricity meters. You might invite a guest speaker from the local power company to share information on power sources and uses or to demonstrate meter reading.


Plug in the Correct Definitions
definitions in bulbs - yarn for cords
elec. words

STUDENT GUIDEBOOK

ELECTRICITY AND MAGNETISM

MAGNETISM

1. Define magnetism ______________________________

____

2. Determine which objects are attracted to a magnet by using one to test the following items. Write yes or no.

Tin Can	____	Penny	____
Glass	____	Rock	____
Pencil	____	Brass Fastener	____
Nickel	____	Paper Clip	____
Chalk	____	Dime	____
Aluminum Foil	____	Thumb Tack	____
Coat Hanger	____	Rubber Band	____

3. Make your own magnet by stroking a steel object in one direction only across a permanent magnet. Repeat 30 times, lifting after each stroke. Test its magnetism on the items above.

4. Are there other methods of magnetizing objects?

____

____

5. How might a magnet lose its magnetism? ______________

____

____

6. Brainstorm all the items you can think of that contain magnets.

____

____

____

____

7. Write a short concise poem about a magnet.

____

____

____

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____

MATERIALS THAT MAGNETIC FORCE CAN PASS THROUGH

1. Use a strong magnet on one side and a steel object on the other and identify which of the following materials will allow a magnetic force to pass through:

   Make a prediction - then test it.

MATERIAL	PREDICTION	OUTCOME
Paper		
Card board		
¼" Plywood		
2" Wood		
Plastic		
Aluminum Foil		
Glass		
Tin Can		
Copper		
Steel		
Water		

2. Analyze why the magnetic force could not pass through certain materials. ______________________________

   ____

   ____

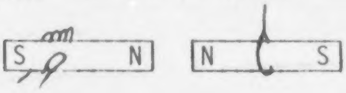
3. Invent a game that could use a magnetic force passing through a material. Draw and label it here:

THE LAW OF MAGNETIC ATTRACTION

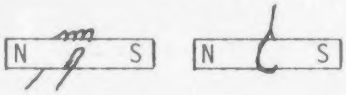
1. Examine a bar magnet. Tell what you think the N and the S stand for: ____

   ____

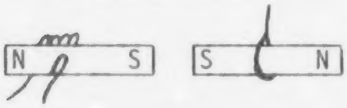
2. To discover the reaction between the poles of two magnets, suspend one magnet in mid-air by its midpoint. Touch the poles of another magnet to the poles of the suspended magnet. Record the results:



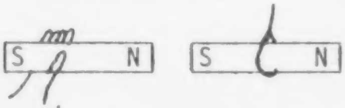
a. __________



b. __________



c. __________



d. __________

3. Using the results of this experiment, write a scientific law relating to "like poles" and "unlike poles" being attracted or repelled. ____

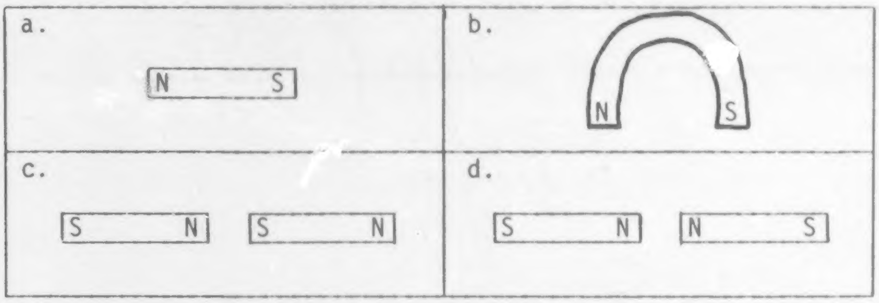
   ____

   ____

4. Invent a unique machine using magnetism to push or pull other objects in a way nobody has thought of before. It could be for work or for play - for indoors or out. Draw it here:

MAGNETIC FIELDS

1. How can the invisible lines of force around a magnet be observed? Try the following experiment and draw the patterns that appear:
   Place a sheet of clear plastic over a magnet(s).
   Sprinkle with iron filings (or steel wool cut up).
   Tap the sheet until a pattern appears.



2. Tell how these patterns reflect the "Law of Magnetic Attraction:"

3. If you were the north pole on a magnet, what things in the world would you like to be charged as south poles?

4. What things would you like to be charged as north poles?

5. Would you rather be a permanent magnet or a temporary magnet? Why?

EARTH AS A MAGNET

1. How does a magnetized object align itself when freely suspended by its midpoint? Which direction does the N pole eventually face?

____

2. Make a small flat boat of styrofoam. Crease a groove across the top. Magnetize a needle and place it in the groove on the boat. Place this in a glass container of water. Which direction does the N pole eventually face? Why? ______________________

____

3. From the experiments above explain how the earth itself acts as a magnet. ______________________________

____

____

____

4. Research the discovery of the North Pole and the South Pole. Write a short story about one of these discoveries.

____

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COMPASSES

1. How do you read a compass? Hold a compass in a horizontal position at waist level and face each of the following directions. North, East, South, West, Northeast, Southwest, Northwest, Southeast.

2. Now look at the numbers on the compass. Can you
   face 90°? What direction is this? ____________
   face 270°? What direction is this? ____________
   face 180°? What direction is this? ____________
   face 360°? What direction is this? ____________

3. Can you set up compass readings for someone to follow taking a designated amount of steps toward a certain degree reading?

   DEGREE STEPS

   a. ____
   b. ____
   c. ____

4. Set up parallel compass courses ending in the same location for a Compass Treasure Hunt for two teams.

   TEAM 1 TEAM 2

COMPASS READING	STEPS	COMPASS READING	STEPS

5. Interview some community resource people to find ways of determining directions without using a compass.

RESOURCE	PROCESS
a.	a.
b.	b.
c.	c.
d.	d.

6. Write a creative autobiography. Imagine you are the needle on an old compass. Tell about the most exciting day in your life.

STATIC ELECTRICITY

1. What produces static electricity? ______________________________

____

2. Comb your hair rapidly with a hard comb, or rub the comb with a wool cloth. Touch the comb to the following items and observe the reaction.

ITEM	REACTION
tiny bits of paper	
chalk dust	
inflated balloon	
mixture of salt & pepper	
plastic sheet	
sawdust	
iron filings	

3. Why were some items attracted? ______________________________

____

4. Try the following experiment.

   a. Place a thin sheet of plastic over a piece of paper. Lift it off. Reaction? ______________________________

   b. Place the plastic on the paper again and rub it hard for 30 seconds. Now lift it off. Reactions? ____________________

   ____

   c. Place two sheets of plastic together. Lay these on the table and rub the top sheet hard for 30 seconds. Now turn them over and rub the other side hard for 30 seconds. Hold them up side by side. Reaction? ______________________________

   ____

   d. What rule about static electricity could be inferred from these experiments? ______________________________

   ____

   ____

5. On another sheet of paper, tell how a charge of static electricity might be used to "save the day."

ELECTRIC STORMS

1. Consult an encyclopedia about lightning. What causes lightning?

____

____

____

2. Draw a landscape during an electrical storm. Identify on your drawing the possible origin and destination of the positive and negative charges.

3. What safety rules should be followed during an electric storm? Tell why each needs to be followed.

RULE	EXPLANATION
a.	a.
b.	b.
c.	c.

4. Evaluate the effectiveness of lightning rods. ________________

____

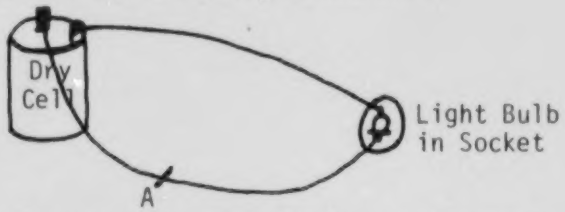
____

5. Share with the class how you feel during an electric storm.

ELECTRIC CURRENTS

1. If electric current is the flow of negative charges from one position to another, then what is an electrical circuit?

   a. Assemble the following materials:



   Now cut the wire at point A. What happened?

   ____________________ Why? ______________________________

   ____

   b. Touch the two exposed ends of the wire to the following materials to see if they will conduct the electricity to complete the circuit. Make a prediction - then test it:

	PREDICTION	OBSERVATION
steel knife		
aluminum foil		
glass		
door key		
pencil		
rubber band		
plastic spoon		
notebook		
dime		

2. Write a definition for "conductor." ______________________________

   ____

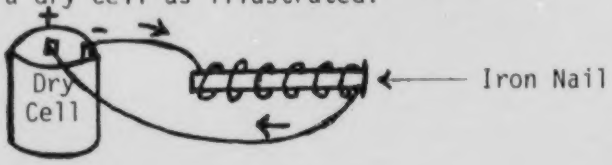
3. A nonconducting material is called an insulator. Survey places where electrical insulation is required for safety and tell why.

WHERE	WHY

4. Make a poster on the theme "Electricity in the Home."

ELECTROMAGNETS

1. Construct an electromaget circuit by coiling insulated wire around an iron nail and attaching the ends to the two terminals on a dry cell as illustrated:



Touch the nail to a pile of paper clips. How many clips will your new magnet pick up? ____________

2. Now experiment with variations of this to see how the magnetic force can be altered.

# PAPER CLIPS

Use two nails together: __________
Wrap nail 50 times: __________
Use pencil instead of nail: __________
Use two dry cell bateries: __________
Detach the wire from one terminal: __________

3. Based on the experiment above, what is necessary to increase the power of an electromagnet?

a. ____

b. ____

c. ____

4. Assess situations where it might be preferable to use an electromagnet which can be turned off and on rather than a permanent one which is always magnetic.

____

____

____

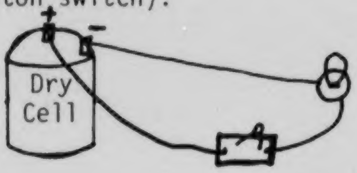
5. Brainstorm some occupations that might use electromagnets.

OPEN AND CLOSED CIRCUITS

1. How is a switch used in an electrical circuit?

   ____

2. Wire a simple circuit together inserting a knife switch (or push button switch).

   a. Observe the light as the switch is opened or closed.

   b. Conclusions:

   In an open circuit ______________________________

   ____

   In a closed circuit ______________________________

   ____

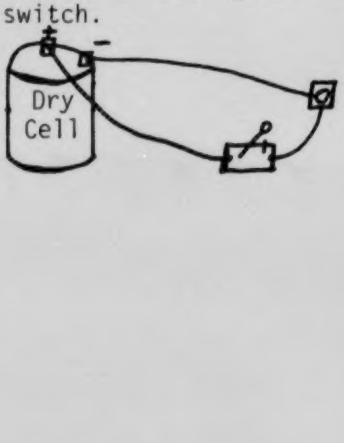
3. List the types of switches you can find. Draw these.

4. How can a simple message be sent by using electrical circuits?

   ____

   ____

5. Wire a circuit using a buzzer instead of a bulb, plus some type of switch.

6. Compose and send a message using the International Morse Code.

A = .-
B = -...
C = -.-.
D = -..
E = .
F = ..-.
G = --.
H = ...
I = ..
J = .---
K = -.-
L = .-..
M = --
N = -.
O = ---
P = .--.
Q = --.-
R = .-.
S = ...
T = -
U = ..-
V = ...-
W = .--
X = -..-
Y = -.--
Z = --..

Message: ____

____

____

____

____

____

____

7. Decode other students' messages on another sheet of paper.

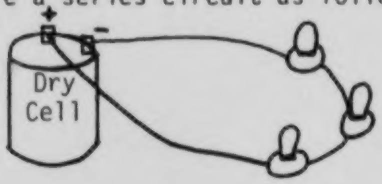
SERIES AND PARALLEL CIRCUITS

1. How can the wiring of a circuit affect the electrical system?

   ____

   ____

2. Wire a series circuit as follows:



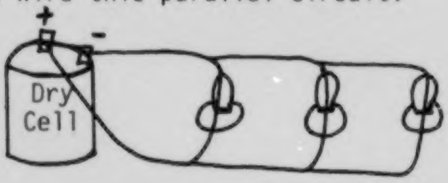
   a. Observe action when the circuit is complete: ____________

      ____

   b. Observe action when one bulb is removed: ______________

      ____

3. Now wire this parallel circuit:



   a. Observe action when the circuit is complete: ____________

      ____

   b. Observe action when one bulb is removed: ______________

      ____

4. Which circuit is preferable for a string of Christmas tree lights?

   ______________________ Why? __________________________________

   ____

5. Imagine that electric power is cut off from a city. If you are the leader of the city government, which buildings would you supply emergency power to from back-up generators? List in order of priority. Be able to defend each choice.

   ______________________________   ______________________________

   ______________________________   ______________________________

   ______________________________   ______________________________

   ______________________________   ______________________________

DISCOVERERS OF ELECTRICITY

1. Draw a cartoon of Ben Franklin's famous experiment with the kite and the key.

2. Apply your knowledge of static electricity and tell why Franklin was successful. ______________________________
____
____
____

3. Can you think of a less dangerous way he might have proven the same theory? ______________________________
____
____

4. Choose a famous inventor or discoverer in the field of electricity. Collect and organize data and prepare a short skit for the classroom about the discovery or invention.

Edison
Oersted
Morse
Faraday
Sturgeon
Thompson
Maxwell
Hertz
Volta
Watson
Ampere
Ohm
Marconi
DeForest
Tesla
Bell
Franklin
Bevis
Kleist
Musschenbroch

5. Choose one of these inventors and create a mural showing his important inventions.

SOURCES OF ELECTRICITY

1. Where does our household electricity come from?
   Draw the various forms of wiring from the lamp in the diagram toward the source of its energy.

2. How does a turbine work? ______________________________

   ____

3. A Hydroelectric Plant uses ______________________________ to turn the turbines.
   Name some famous hydroelectric plants and their locations:

   ______________________ at ______________________

   ______________________ at ______________________

   ______________________ at ______________________

   Why were they located at these particular sites? ____________

   ____

4. Fuel Burning Plants burn ____________, ____________, or ____________ to produce heat to produce steam to turn the turbines.
   Name some local plants using this process and their locations.

   ______________________ at ______________________

   ______________________ at ______________________

   ______________________ at ______________________

5. Nuclear Power Plants use ______________________________ to create steam to turn the turbines.
   Name some famous nuclear plants and their locations.

   ______________________ at ______________________

   ______________________ at ______________________

   ______________________ at ______________________

6. Choose one power source: nuclear, fuel burning, or hydroelectric. Debate either the advantages or disadvantages of this source with another classmate.

7. Brainstorm other sources of power.

______________________   ______________________
______________________   ______________________
______________________   ______________________
______________________   ______________________

8. Which of these would be the most cost efficient? ____________

Why? ____

Which one of all the power supplies is the best for the environment? __________________ Why? __________________

____

USES OF ELECTRICITY

1. How is electrical energy converted into other forms of energy?

   ____

   Observe and note the results of energy in the following:

   Turn on a lamp ______________________________

   Ring a doorbell ______________________________

   Turn on an electric mixer ______________________

   Turn on a fan ______________________________

   Turn on a television __________________________

   Turn on a blow dryer __________________________

   What forms did the electrical energy take?

   a. ____

   b. ____

   c. ____

   d. ____

2. Tell how the peak load affects the amount of electrical energy available in a given area. ______________________

   ____

   ____

3. Why is it important for consumers to conserve their use of electricity to keep this peak load down?

   ____

   ____

   ____

4. Invent a new electrical device that converts energy into mechanical motion. First brainstorm for ideas; then make a drawing and label all the parts. Present your drawing to the class and explain how the device works and its possible uses.

ELECTRICITY MEASUREMENTS

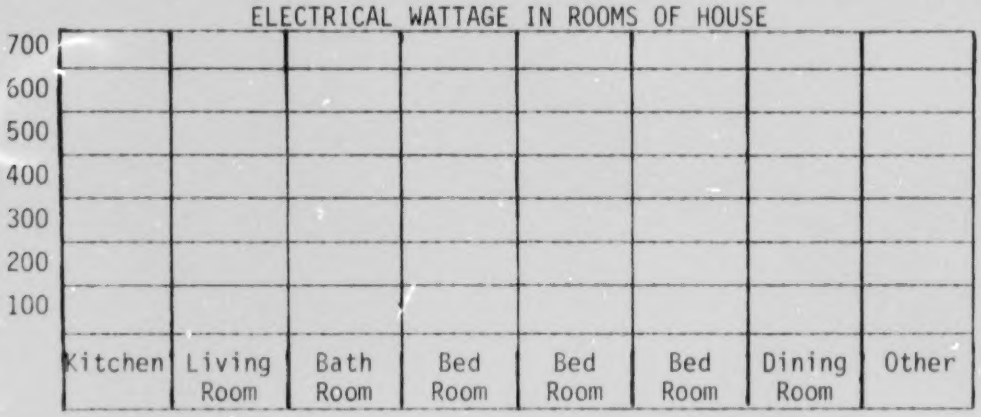
1. How can electrical energy be measured?
   Find an electric meter.
   Write down the numbers. ☐ ☐ ☐ ☐

   Return one hour later and write down the numbers again. ☐ ☐ ☐ ☐

   How many kilowatt hours were used? ______________________

2. Count the number of light bulbs in your house. Add the number of total watts. Make a bar graph to compare the wattage in the rooms.

ELECTRICAL WATTAGE IN ROOMS OF HOUSE



3. Compose a creative story about a time when the electricity was off for 72 hours in your own home. Try to think of all the daily uses of electric energy that would no longer be available. Develop some alternatives.

For a free pamphlet on How to Read Your Electric Meter, write to:

Federal Energy Regulatory Commission
Division of Public Information
825 North Capitol STreet, N.E.
Room 1000
Washington, D.C. 20426

EDISON BOOKLET

To complete our unit on electricity, each student is responsible for a booklet on Thomas Edison. Your booklet must include the following:

1. Read a book about Edison. Choose one of the following projects to do:
    a. Write an autobiography of Edison in which you tell how you invented something and how you felt while you were doing it.
    b. Make a mural to display on the wall showing Edison's important inventions (you may work with a partner).
    c. Write and put on a play about some important event in Edison's life. This may be a group project.
    d. Write a two-page book report on the book you read.
    e. Any project approved by teacher.
2. Make a glossary of terms including definitions. Your glossary must include at least ten words that we would not be using if it were not for Edison and his inventions.
3. Make two drawings. One must show a street in a town or city before the invention of the light bulb. One must show the same street after the invention of the ligth bulb. Date both drawings.
4. Count the number of light bulbs in your house. Make a picture graph showing how many bulbs are used. Add up the number of watts used in all the bulbs in your house. Put this number on your graph.
5. On a map, illustrate places where Edison lived, worked, and invented. Use a picture to show what is important in each place.
6. Make a time line showing Edison's life and important events in it.
7. Choose an electricity experiment to demonstrate to the class. Include a write-up of the experiment in your booklet.
8. Anything else you want to include.
9. A creative, original cover.

The booklet is due ____________________.

You will be evaluated on the: cover
completeness of the booklet
neatness
creativity
originality

Weather

TEACHER'S NOTES

While using this weather unit, the daily weather conditions should be observed and recorded. Compare predictions seen on T.V., radio, and the paper with the actual conditions that develop. Each student should get involved with this process as it relates directly to his daily life.

The teacher needs to locate many applicable reference materials and instruments, charts, graphs, pictures, etc. for student use. Resource people might include meteorologists, pilots, radio or T.V. personalities, farmers and gardeners.

It is important to make the study of weather meaningful to the students and to arouse their curiosity to look beyond the obvious.

Weather Lore and Mythology (Guidebook, page 125)

Students may be asked to recall a time when weather affected them in a serious way. This will involve them personally in the unit on weather and may stimulate them to be curious about the causes and effects of weather conditions.

Try to locate resource books where the weather lore may be read and shared by the students.

Meteorology (Guidebook, page 125)

A daily weather chart should be kept by the students so that the interrelationships of the various factors can be perceived and even used to forecast the weather. A field trip to a local weather bureau or a nearby airport would furnish an excellent opportunity to see a meteorologist at work. This would be a good introduction to the weather instruments used.

Weather Instruments (Guidebook, page 128)

Try to have as many weather instruments as possible in the classroom for display, demonstrations and use. Many of these tools may be handmade with readily available materials.

The weather satellite Trio and Nimbus are good research subjects and could lead into discussions on weather control and its political implications.

Atmosphere (Guidebook, page 129)

Materials: A glass, a large container with water depth so that glass can be submerged.

Many experiments prove that air takes up space. This is one of the simplest ones. Inflating a balloon or creating an air current are others. The students might find other experiments to share with the class, some from their scouting or outdoor activities.

Temperature (Guidebook, page 129)

Materials: Various thermometers - baby, cooking, indoor, outdoor, aquarium, digital.

In helping the students to examine the instruments, the teacher will need to provide cold and warm areas or solutions in the classroom. This will provide direct evidence of the effects of temperature on the thermometers.

Air Pressure (Guidebook, page 130)

Materials: A glass of water and a straw for each student.

Extension of this lesson might include information about aerodynamics and the machinery involved or even the space program and how NASA solved its air pressure problems.

Air Masses (Guidebook, page 131)

The teacher may prepare the map as a classroom activity or direct each student to prepare his own map. One method of sharing information in an interesting format might be a reenactment of a televised weather report. A brief report at the beginning of each lesson on weather could involve various students.

Winds (Guidebook, page 132)

Materials: (A prepared convection box or the following materials for student assembly) sturdy box with one side cut away and two holes in the top, a candle, a sheet of flexible plastic, two lantern chimneys, matches, a piece of wood or rope, tape, a turntable, a record, string, chalk.

Check that the plastic sheet is secured on all sides after the candle is lit or there will be air leakage in the convection box,

Students might prepare and present illustrated reports on the wind belts.

Clouds (Guidebook, page 135)

Materials: Quart glass bottle or flask, ice cubes, heat source to boil water, piece of screen.

Have the students chart daily observation of cloud formations. Students might look through magazines to collect pictures of the various types of clouds. These could then be classified and used to make individual posters for a composite visual display.

Precipitation (Guidebook, page 136)

Materials: One cup of sugar or alum, glass jar or beaker, heat source, spoon, small bar, thread.

Relate how precipitation is a part of the water cycle. The teacher might ask students to interpret the following: "Last winter's snow is this summer's rain."

Various experiments on evaporation related to surface area, heat, air movement, and humidity that could be performed.

Violent Storms (Guidebook, page 136)

Most students will find violent storms fascinating and will need little motivation to study them. They may be overwhelmed with the volume of information; therefore, the teacher may elect to direct the students to choose a specific storm to research.

In listening to each other's reports, the students may be guided to infer the overall concepts and geographical implications in this study.

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STUDENT GUIDEBOOK

Weather Lore and Mythology

1. Brainstorm and list all the kinds of weather you can think of.

   ____

   ____

   ____

   ____

   ____

2. Start collecting weather sayings. List them in the back of this book. You can read Mother Goose rhymes and ask older people you know. Ex. "My knee hurts; I think it's going to rain."

3. Make a booklet for younger children. Illustrate some weather sayings and explain them.

4. In groups, make a mural to show the gods who controlled weather according to mythology of Egypt, Greece, the Vikings, and American Indians.

5. Evaluate your group's mural on a scale of 1 - 10.

   1 2 3 4 5 6 7 8 9 10

   originality ________
   authenticity _______
   creativity ________

   _______ average

Meteorology

1. Define meteorologist. ______________________________

   ____

   ____

2. List the responsibilities of a meteorologist.

   ____

   ____

   ____

   ____

3. Write to: American Meteorological Society
45 Beacon Street
Boston, Mass. 02108

Ask for information on what a meteorologist does and the training and background experience required for this vocation.

4. Read about a famous event in history that was affected by the weather, such as Washington's crossing the Delaware. Write a weather report that a meteorologist might have made then. Share this with the class.

How did the weather help or hinder Washington?

5. Can a meteorologist be creative and original in his/her job? Why or why not?

6. Be an amateur meteorologist. Paint a compass on the school grounds near the flag. This will be our class's wind indicator.

7. Draw our wind indicator.

8. Make a weather chart. Record data everyday at the same time. (See chart on next page.)

Older students may wish to keep a more accurate and detailed weather watch. Information needed to complete the chart may be obtained by newspaper, radio, TV forecast or calling the weather station.

WEATHER CHART

DAYS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Date																					
2. Time																					
3. Temperature (Celsius)																					
4. Barometric pressure																					
5. Relative humidity																					
6. Dew point																					
7. Wind direction																					
8. Wind speed																					
9. Amount of precipitation (rain, snow, sleet)																					
10. Cloud type																					
11. Percentage of sky covered by clouds																					
12. Weather description																					

Weather Instruments

1. Research and draw instruments used to measure:

   a. Precipitation

   ____

   b. Wind

   ____

   c. Temperature

   ____

   d. Air Pressure

   ____

   e. Humidity

   ____

   f. Total Earth Weather Conditions

   ____

2. What part does radar play in weather forecasting?

   ____

   ____

3. Evaluate the use of the new Space Shuttle as related to weather forecasting.

   ____

   ____

Atmosphere

1. Define "Air": ______________________________

____

To prove that air is matter and as such it takes up space and has weight try the following:

Place a crumpled paper in the bottom of a glass.
Invert the glass and push it straight down under the water in a large container. Remove it and check the paper. How does it feel? ______________________________

Why? ______________________________

____

2. The air around the earth is called its atmosphere. Identify the four basic levels and one object that could be found in each.

1. ______________ ______________
2. ______________ ______________
3. ______________ ______________
4. ______________ ______________

3. Compare the safety and speed in flying an airplane at an altitude of one mile to an airplane flying at an altitude of 10 miles. At what altitude would you fly your airplane if you were a pilot? Why?

____

____

____

____

____

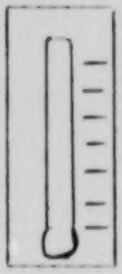
Temperature

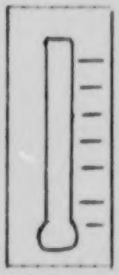
1. What temperature is it now? ______ °F, ______ °C

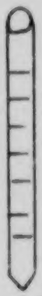
Identify all the factors that may have caused this current temperature:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________

2. Compare an outdoor thermometer with a cooking thermometer.


Farenheit


Celsius


Cooking

Label the important temperature readings on each. Why are they different?

____

____

3. To discover the effects of the solar heat on different soils, try the following experiment.
   Place light colored soil in one jar.
   Place dark colored soil in another jar.
   Put identical thermometers in the soil in each jar and place in the sun.
   Read the temperature after several hours.
   Observation: ______________________________

   ____
   How does this relate to the earth's surface?

   ____

   ____

4. If you had to adapt to a completely different climate, how would your daily activities be affected?

____

____

Air Pressure

1. Find out how many pounds of air pressure are exerted on all exposed matter at sea level. ______________________
   Do you think pressure would be greater or less at the top of a mountain? Tell why. ______________________

   ____

   ____
   How about under the earth in a deep mine shaft? Would pressure be greater or less? Why? ______________________

   ____

   ____

2. Observe air pressure at work:
    Place your finger over the top of a straw.
    Insert this straw into a glass of water.
    Observation: ______________________________
    Raise your finger. Observation: ______________________
    What is holding the water in or out? _________________

3. Think of a unique way people could use air pressure. Make a drawing and label it here.

Air Masses

1. What is an air mass?

____

____

2. Complete this chart.

NAMES OF NORTH AMERICAN AIR MASSES	COLD	WARM	DRY	MOIST

3. On a map of North America, draw the six masses. Use arrows to show the movement.

4. Define "fronts" as related to weather.

____

5. Draw the symbols for:
    cold front ______________
    warm front ______________

6. Why do you think these are effective symbols?

7. Make a bulletin board for the class to use each day. Put up a large map of North America. Make appropriately-sized weather symbols to tack on the map each day.

8. Collect weather maps from the newspaper for a week's time. Paste them on a sheet of paper in order. Analyze the movement of air masses and fronts for the week. What do you observe?

9. Using your weather maps from #7 write a weather forecast for the next day. Use all the weather words you think a meteorologist would use.

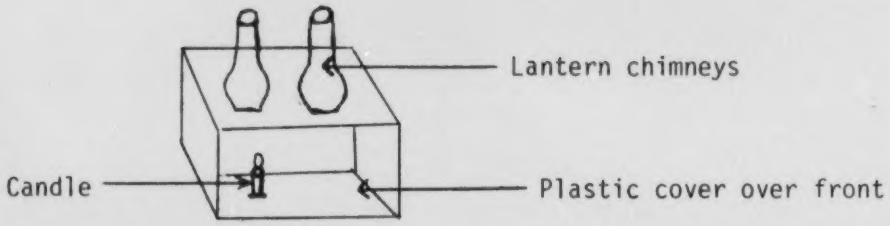
Read your forecast to the class, while pointing to a large map.

Winds

1. How can heating and cooling cause winds to blow?

   Unequal heating of the earths surface can be seen by the following:
   Place soil in two equal boxes.
   Insert identical thermometers in each to the same depth of soil.
   Arrange one box so that it receives slanted rays from the sun and the other so that it gets direct rays.
   Read the temperature every ten minutes.
   Tell how you think this relates to the earth surface.

   Set up a convection box to see how hot and cold air move.
   (See following page.)

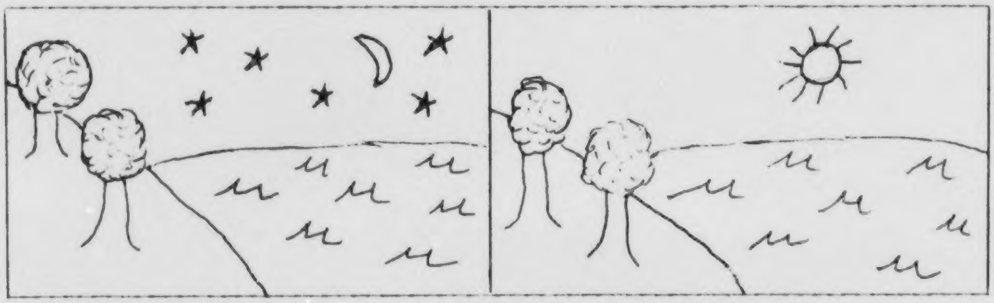


Light the candle, secure the plastic, then hold a smoking piece of wood, rope, or twisted paper over the chimney on the right. Draw arrows to show how the air moves through the box.

Conclusion: Hot air moves ______________________________

Cold air moves ______________________________

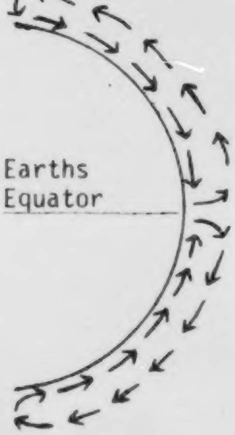
2. Land and Sea Breezes
Using the information from above, identify which direction the breeze is blowing.

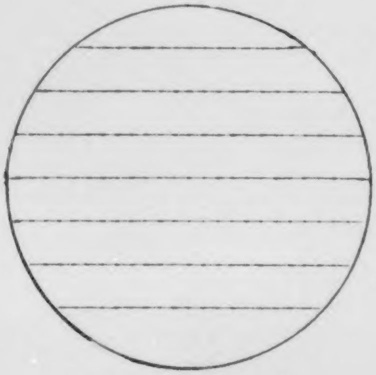


2:00 a.m. 2:00 p.m.

As heat and coolness causes air movement, the rotation of the earth (also) affects the direction of movement. This is called wind deflection.

Try this experiment to see rotation effects: Place an old record on a turntable with the center hole to represent the North Pole. Spin it slowly (counter-clockwise) by hand to represent the earth's rotation. As it is turning, draw a chalk line from the center directly toward yourself. Remove the record and visualize what would happen to cold air moving south from the North Pole.

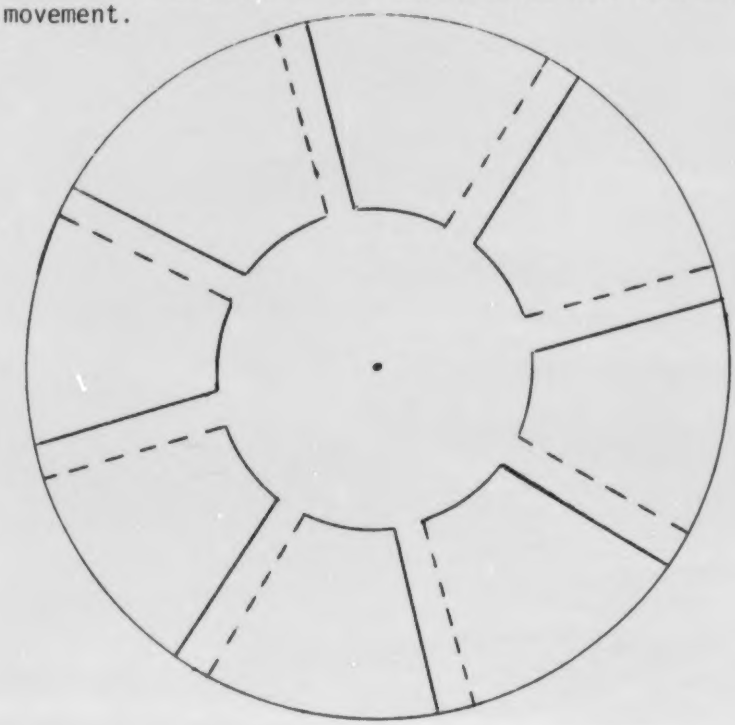




Label Wind Belts

Research to find the names for the wind belts in the different latitudes on the earth's surface.

3. Create your own Convection Detector. Cut out this figure on the solid lines and fold flaps downward along the dotted lines. Suspend on a string attached at the center. Hold over a heat source and observe the movement. Now hold over a cool source and observe the movement.



Clouds

1. List the 3 main cloud types and their symbols.

   a. ______

   b. ______

   c. ______

2. Create a picture that shows the 3 main cloud types. Use dark paper and cotton balls.

3. Scientists add prefixes to cloud names to describe them more accurately. Define these prefixes:

   a. alto ______

   b. nimbus or nimbo ______

   c. fracto ______

4. Write the names of clouds that have these prefixes and define them.

   a. ______

   b. ______

   c. ______

   d. ______

5. Make a cloud: Use a quart juice bottle or flask, ice cubes, boiling water, piece of screen.

   Place a cup of boiling water in the bottle. Pour out all but 2 inches of water. Quickly place the screen on top of the bottle and the ice cubes on top of it. Hold a dark color in back of the bottle and you see a cloud forming.

   What caused the cloud to form?

   ______

   ______

   ______

6. Be creative. Write similes.
   Ex. A cirrus cloud is like . . . . .

   a. ______

   b. ______

   c. ______

   d. ______

Precipitation

1. Precipitation: all forms of moisture that fall from the atmosphere. List all the forms you can think of.

   __________ __________ __________

   __________ __________

2. Make crystals with either sugar or alum:

   Put one cup of water into a pan and warm it. Slowly add sugar or alum until the solution is completely saturated, stirring constantly.

   Pour the solution into a glass container. Suspend a thread from a bar placed across the top of the container. Watch what happens daily.

   Tell how this relates to precipitation. ____________________

   ____

   ____

   ____

3. If the atmosphere were completely clean of all pollutants such as dust, pollen, or soil particles,how would precipitation be affected?

   ____

   ____

4. Research in newspapers and magazines for pictures and stories relating to precipitation. Create a bulletin board in the classroom to illustrate these.

5. Make a flipbook showing the formation of a hailstone.

Violent Storms

1. Hurricanes and Tornadoes can be very destructive. Do some research on hurricanes - choose one particular storm. Trace its path on an area map telling where it originated and who it affected. Share clippings, pictures, and your information with the class.

2. What do hurricanes, typhoons, cyclones, baguios, and willy-willies have in common? ______________________________

   ____

3. Compare a hurricane with a tornado. How are they alike, how are they different? ______________________________

   ____

   ____

   ____

4. Make a poster showing safety precautions that should be taken at the approach of either a hurricane or a tornado.

Plants

PLANTS

Teacher Plans and Strategies

The plant unit is divided into the following eleven subtopics:

I. The Study of Nature

II. The Plant Kingdom

III. Bacteria, Algae, Fungi, Lichens

IV. Mosses and Liverworts

V. Ferns

VI. Weeds and Grasses

VII. Trees and Shrubs

VIII. Flowers

IX. Herbs

X. Plants as Medicine

XI. Field Trip Book

1. The teacher may choose to use only a few sections or all of the plant unit. Different students may be assigned different sections or questions.

2. It is important for the teacher and students to work together to obtain information and necessary materials. The student can benefit from searching in the school and public libraries for this information.

3. Most answers to questions in the student booklet can be recorded on the lines provided; however, some questions may be answered on separate paper. Students may evaluate theirs and other's work after performance criteria are established.

PLANTS

I. The Study of Nature

A. Give the "Nature Quotient" (NQ) test before and again after studying the unit. Each question is worth 15 points. The teacher will subjectively score each test. He/she may either collect the papers and score them or may have the students trade papers, read answers aloud and the teacher will tell the student how many points to give each question. Each student will total the points and determine which range he falls into. The NQ ranges are as follows:

below 55 - - - You are an oak stump!

55 - 69 - - - You are a weed.

70 - 84 - - - You are an herb.

85 - 115 - - - You are a flower bud.

116 - 130 - - - You are a rose bush.

130 - 150 - - - You are a mighty oak.

It is a good idea to display an NQ chart (made by students) to stay on the wall throughout the unit. It could be done in the following manner:

	oak stump below 55	weed 55-69	herb 70-84	flower bud 85-115	rose bush 116-130	mighty oak 130-150
John	0			*		
Kim		0			*	
David		0				*
Sue	0			*		
Mrs. Smith		0			*	

0=before

*=after

B. Why Study Nature?

1. See the Brainstorming section, page _____. Let one student be the "secretary" to record responses on paper while the teacher writes them on the board. Then the teacher will have a copy to keep. After ranking and recording the "top ten," let a student write them on construction paper with a magic marker to display.

2. First, students need to define "infinitely," "resilient," and "undiscriminating." The meanings should be discussed in class. Next, have students write their personal interpretations of the quote. Then let the students read their responses aloud and lead a class discussion with questions like:

   a. Give examples of how nature is patient. - - - resilient. - - - undiscriminating.

   b. Why is it so pleasant to look at nature in this perspective?

3. The teacher will need to explain what is meant by the theme of a poem. Students should write their own feelings and then share them with the class. Suggested discussion questions:

   a. Compare your feelings about the poem with another classmate's reaction.

   b. Compare the themes of these poems.

   John Clare is a poet whose works might be used in this unit.

4. Review a business letter form with the students. Names of organizations and addresses can be found in the school or public library or the local United States Department of Agriculture.

5. Assist the students in locating information about different botanists. Encourage students to make inferences about the motivation, characteristics, and personal values of the individual from information that has been gathered.

II. The Plant Kingdom

A. Plant Classification

1. and 2. The student can find the subdivisions of the classification system in an encyclopedia. One source is Edward Victor, Science for the Elementary School, New York Macmillian Company, 1980. Suggested discussion questions:

   a. Are all living things classified in this manner? Why is it necessary? Why are there so many subdivisions?

   b. How are these subdivisions useful to man?

3. Assist students in locating botany books. The local library and high school and college science departments and libraries are possible sources. Locate and have available sources which contain information about plant and human life processes.

4. The information about plant life processes can be found in Science in the Elementary School and the human life processes in the encyclopedia. Student(s) will need poster board, rulers, and magic markers for the chart. Suggested discussion questions:

    a. In which life process were plants and humans most alike? - - - least alike?

    b. Rank the life processes for plants from what you think are the most necessary to live to least necessary. Do the same for humans. How and why are they different?

III. Bacteria, Algae, Fungi, Lichens

*A. Experiments with Bacteria

1. Examining bacteria under a microscope. Materials to be collected: needle, cork, matches, microscope slide, microscope, methylene blue or eosin. The coloring agent may be obtained from a drugstore where the pharmacist can prepare the proper dilution for you. The teacher needs to help the students focus and adjust the angle and amount of light entering the microscope.

   If the variety of bacteria is limited, grow others by placing dead or decaying grass in a large, wide-mouth jar of water. Expose to air 1-2 days, then cover and let stand 2-3 days. A good supply of bacteria should now be in the water. Use in the same manner as the experiment calls for. Suggested discussion questions:

    a. Why did the coloring agent need to be diluted?

    b. Why do we have to observe bacteria under a microscope? Why use different powers?

    c. Before we continue, what can you conclude about the structure and reproduction of bacteria from your observations?

2. Conditions for growth of bacteria. See student booklet. Suggested discussion questions:

    a. (After conclusions are drawn) Why do you think bacteria grow best in dark, moist, warm places?

    b. What was the purpose of the "nutrient culture material?"

*Caution: Experiments #1 and #2 should be performed only by the experienced teacher under controlled conditions.

B. Thinking Processes - Bacteria

1. Provide students with resource materials such as encyclopedia or Science in the Elementary School. Provide student(s) with poster board, markers, and ruler. Suggested questions:

    a. How are the bacteria structure, locations, and growth interrelated? Why?

2. A filmstrip-making kit is available from:

   Suggested discussion questions:

   a. (Answer to problem - 1024) At this phenomenal rate, why do you think the world is not overtaken by bacteria?

   b. How did you explain a scientific process through a visual art form? What did you learn from making the filmstrip?

   c. What happens to bacteria when conditions are unfavorable?

3. Suggested discussion questions:

   a. Brainstorm the ways harmful bacteria can be controlled. (See Science in the Elementary School.)

   b. Can you think of some creative ways of controlling harmful bacteria?

4. Discuss with the students the purpose and journalistic style of editorials. Bring a few newspaper editorials to class for models.

5. Suggested discussion questions:

   a. Have students proofread their own and other's editorials. After proofreading,each student should tell in a sentence the viewpoint he/she was advocating.

   b. Can you think of other ways bacteria may be helpful?

C. Experiments with Algae

1. & 2. Collecting and examining algae
Materials to collect: Six wide-mouth jars, eye dropper, microscope slide and cover, microscope, books with pictures of algae.

   Suggested questions:

   a. Describe the differences seen among algae found in different places. Why do you think they were different?

   b. Discuss observations and reasons for conditions best for algae growth.

3. Examining seaweed or kelp
Either collect kelp or seaweed from the ocean beach or obtain some from a fish store. It is used to pack many seafoods.

   Suggested questions:

   a. What do you think are the purpose of the air bladders and holdfasts?

D. Thinking Processes - Algae

1. Information about algae varieties and structure can be found in library resources. Suggested questions:

   a. What are the similarities and differences of the structure of algae and bacteria?

   b. Why is algae so slimy?

2. For information use reference materials. (Ex. - Science in the Elementary School) Suggested questions:

   a. Why do you think some kelp gets so large? (150 ft.)

   b. Is there any difference in the color of kelp in and out of salt water?

3. Use reference materials. Suggested questions:

   a. Do you think we could ever run out of algae? Why?

   b. What other possible uses are there for algae?

E. Experiments with Fungi, Yeast, Mushrooms, and Lichens

1. Collecting and growing molds
   Materials to collect: bread, container (like butter tub), magnifying glass, transfer needle, eye dropper, coloring agent, microscope slide and cover glass, microscope

   After two days, bread will have white cottonlike mold. After 4-5 days, black spots (spore cases) will appear. Suggested questions:

   a. What differences were observed with a magnifying glass and with the microscope?

   b. What are the best conditions for mold growth?

2. Growing and examining yeast cells
   Materials to collect: sugar, one package of yeast, materials to make microscope slide, microscope
   Suggested questions:

   a. Draw a diagram of a yeast cell on the board. Compare each other's and discuss.

   b. What purposes for yeast do you know of?

   c. Have students smell the yeast culture and note the odor of ethyl alcohol. Point out that the yeast causes the sugar solution to ferment, producing ethyl alcohol and carbon dioxide.

3. Yeast action on dough.
   Materials to collect: 5-6 cups of flour, 1½-2 cups of water, 2 tablespoons of sugar, 1 teaspoon of salt, ¼ cup of oil, one package of yeast, and two bread pans. Suggested questions:

   a. Have any of you ever made bread or watched anyone make it?

   b. Which do you like better - homemade or store-bought bread? Why? You may wish to compare ingredients and discuss additives and nutrients.

4. Examining mushrooms and making spore prints
   Materials to collect: full-grown mushrooms, scissors, dark and light construction paper, eggs, toothpicks, wide-mouth jars
   Results: the gills of the mushroom will be permanently outlined on the cardboard by the spores that have fallen.
   Suggested questions:

   a. Approximately how many spores are in each spore case? About how many in the mushroom?

   b. Did the color of spores of the mushroom match the color on the paper? Why?

5. Collect and examine lichens
   Materials to collect: lichen, magnifying glass, microscope
   Suggested questions:

   a. The teacher will need to explain what lichens are. What is symbiosis?

   b. What do you think lichens do to rocks? By what process?

F. Thinking Processes. Fungi, Yeast, Mushrooms, and Lichens.

For 1-5, information can be located in Science in the Elementary School, an encyclopedia, or botany reference books.

1. Suggested question:

   a. Name one or two things all fungi have in common?

2. A cookbook may be used. An excellent source is Let's Cook It Right by Adelle Davis.
   Suggested questions:

   a. What is the secret to keeping yeast bread moist?

   b. What vitamin do we get from yeast?

3. Have students use encyclopedias.
   Suggested question:

   a. Did your story depict the old-fashioned or modern wine-making techniques? Explain.

4. Information may be located in *Science in the Elementary School*.
Suggested questions:

a. Explain the purpose of spores.

b. If each spore case contains four spores, estimate how many fell on your paper.

5. Use *Science in the Elementary School*.
Suggested questions:

a. Define symbiosis. Can you think of any other symbiotic relationships in nature? Discuss.

IV. Mosses and Liverworts

A. Activities with Mosses and Liverworts

1. Collecting and examining moss. Mosses may be found in swampy areas, forests, crack of sidewalks, north sides of trees or buildings, etc. Point out to students the tiny leaves, slender stalk, hairlike rhizoids, male and female reproductive organs and spore cases.

2. Growing Moss
Materials to collect: rich soil and humus (may be potting soil), pot, glass, water
Suggested questions:

a. How long did it take the moss to grow? When were they "mature" plants?

b. In what ways are mosses like most other plants?

3. Collecting and examining liverworts. The teacher will need to bring some liverworts to class and identify their characteristics. Then have students bring in samples of their own.
Sample question:

a. What do liverworts look like to you?

B. Thinking Processes - Mosses and Liverworts

1. Use encyclopedia and/or *Science in the Elementary School*.
Suggested question:

How are the early stages of moss reproduction similar to mammal reproduction?

2. Suggested question:

What do mosses and liverworts have in common?

V. Ferns

A. Activities with Ferns

1. Collecting and examining ferns. Before collections, discuss with students where ferns can be found. In examining, show and label fern parts. Discuss purpose of spores. If you are interested in growing ferns in the classroom, Science in the Elementary School gives good directions. Suggested questions:

   a. What are the best conditions for growth of ferns? Why?

   b. Can ferns be found in the winter? in the spring? How do you explain this?

B. Thinking Processes - Ferns

1. Information can be found in The Complete Family Nature Guide. Suggested questions:

   a. What is the true classification of "asparagus fern?" Were you surprised? Can anyone bring one to class?

   b. Have students evaluate each other's speeches in terms of fluency, eye contact, etc.

2. Use Science in the Elementary School or encyclopedia. Suggested question:

   Why do you think some ferns became cool while others became fossilized or just humus? Discuss.

3. Student(s) need paper, boxes, and markers Suggested questions:

   a. Why did you choose this particular setting? What else might have been chosen?

   b. Rank the elements in your "habitat" that are most important to the fern's survival.

4. See encyclopedia or Science in the Elementary School. Suggested question:

   a. Is the reproductive cycle of ferns similar to any other plants you have studied? Which ones? How?

5. Encourage creativity and use the reference information for factual information. The teacher may need to guide the students in how to incorporate facts into a fictional story by producing an example.

Suggested question:

Can you identify the five facts from the story you just heard? Were any of them new to you?

VI. Weeds and Grasses

A. Activities with Weeds and Grasses

1. Provide books about weeds and grasses. (Ex. Family Nature Guide by Jean Resse Worthley.)
Suggested questions:

a. Why would weeds need to be named and classified?

b. Does everyone need to learn all plant classifications? Why? Why not?

2. Suggested question:

a. What kind of grass is best to use? Why?

3. Materials to provide: bamboo, string, glue, paint
Suggested questions:

a. Brainstorm "Uses of Bamboo"

b. Name, describe, and tell purpose or use of what you made.

4. To press weeds and grasses, place the specimen between two layers of tissue and place in book. Leave it in the book 2-3 weeks. Do not expose to air until you are ready to use.
Suggested questions:

a. Identify and name the number of different species used and those in repetition, which are most common to your locale, etc.

B. Thinking Processes - Weeds and Grasses

1. Use Family Nature Guide or encyclopedia.
Suggested questions:

a. Why are plant origins interesting?

b. How did these plants get here from other countries?

2. Use *Family Nature Guide* or other botany books. Suggested discussion question:
    - a. Did you attempt to make your recipe? If so, how was it? (Perhaps students can bring a sample to class.)
3. Use encyclopedia. Suggested questions:
    - a. In what way is sugar cane like bamboo? Other grasses?
    - b. What would our world be like if we had never known about sugarcane?
4. Use *Family Nature Guide* or encyclopedia. Suggested questions:
    - a. Could you identify the five facts? Were any of them new to you?
    - b. Is this use of bamboo realistic? Why?

VII. Trees and Shrubs

A. Activities and Thinking Processes with Trees

1. Provide books about trees. Suggested questions:
    - a. Do you feel any different now about your tree than you did before this project? How and why?
    - b. Has anything happened in real life that gave you the idea for the story? If so, what is different?
2. Provide books about trees or use encyclopedia. Suggested questions:
    - a. What do you think is the one most important thing about trees to man? to nature?
    - b. In what general ways do you see the use and appreciation of trees changing? Why?
3. Use *Family Nature Guide* or encyclopedia. Suggested questions:
    - a. Define "monocot" and "dicot." Which type do each of the four leaf classifications fall into?
    - b. Rank the top 10 collages in the class.
4. See *Family Nature Guide* or other books about trees. Suggested questions:
    - a. Why do dead trees pose an interesting nature study?

b. Often a tree's roots extend as far underground as do the branches above ground. Do you see this root system on dead trees? Why?

5. Help student(s) locate address. If tree seedlings are available, the "Plant a Tree Day" is a good learning experience. Discuss the type of trees they are planting, why they are planting them in a certain location, how long they take to grow, and how old the students will be at different points in the growth cycle. The students may even plan some creative "planting ceremonies."

B. Activity and Thinking Processes with Shrubs

1. Provide books about trees and shrubs. Suggested questions:

a. Have any new trees or shrubs been planted in your yard in the last couple of years?

b. Which grow the fastest (or slowest) in your yard?

VIII. Flowers

A. Activities and Thinking Processes

1. Use learning center, "Persevering Periwinkles" by Sue Clements, (available from Engine-Uity, Ltd.; P.O. Box 9610; Phoenix, Arizona). It contains 72 activity cards covering a vast knowledge base. Activities are based on Bloom's and William's theories. The teacher can easily adapt the number of cards to the students. Books containing reference material on flowers will need to be collected.

2. It will take prior planning to grow flowers at school. The students will learn more since they can discuss each stage of growth.

3. How to press flowers was explained in the section "Weeds and Grasses." If you prefer drying flowers, the directions are printed on the silica gel package. The teacher may assign a different group of students to each process. Dried flowers may be used for pictures, decoupaged on wood or bottles, or used in many other creative projects. Suggested questions:

a. What is the difference in the two processes of the effects on the flower?

b. Brainstorm: "Uses of Dried or Pressed Flowers."

IX. Herbs

A. Activities and Thinking Processes

1. If kitchen facilities and time are available, let student(s) prepare the recipe at school. The teacher and student(s) will need to provide ingredients. Suggested questions:

    a. Describe the herb's individual taste and smell.

    b. How did the herb affect your recipe? How do you think it would have tasted without it?

2. Growing herbs will take prior planning. Seeds can be purchased at garden shops. Let student prepare recipe at home or school and bring to class to be sampled by classmates. Suggested question:

    a. Why did you choose this particular herb? How does it affect the smell and taste of your recipe?

3. Provide poster board, markers, rulers, etc.

4. Suggested question:

    a. Which do you think are the most important values? Why?

X. Plants as Medicine

A. Thinking Processes

1. Provide "Nature's Gifts to Medicine," in National Geographic, September, 1974. Suggested question:

    Had you heard of or taken any of these medicines before? Discuss.

2. Provide biographies and/or encyclopedias. Suggested questions:

    a. Did your play follow the man's true life? How?

    b. Describe the man's single most important discovery and its effect on the medical field.

3. Students should use the same article as in number 1 above.

XI. Field Trip Booklet

A field trip to a park or woods is a pleasant ending to the plant unit. This section includes sample activities. It should be adapted by the teacher to fit a particular field trip site. It is also important that the teacher participate along with the students and complete a booklet during the field trip.

IDEAS FOR BULLETIN BOARDS AND DISPLAYS

Bulletin boards may be created by students or the teacher. If a group of students is assigned the task of creating a bulletin board to accompany the plant unit, several levels of Bloom's Taxonomy may be used. It is also good to display student work such as:

Plant classifications
Chart, "Plants vs Humans"
The many drawings required
Spore prints
Creative stories and poems

An area in the room should be set aside for displays of student products. Be sure to display the "Class Nature IQ Chart." Display pictures of students as they prepare microscope slides or research information or present oral demonstrations or participate in the field trip.

SUGGESTED SOURCES FOR IMPLEMENTATION OF THE PLANT UNIT

Adams, Richard. Nature Through the Seasons. New York: Simon and Schuster, 1975.

Aikman, Lonnelle. "Nature's Gifts to Medicine." National Geographic, September, 1974.

Clements, Sue. "Persevering Periwinkles." (Learning Center) Phoenix, Arizona: Engine-Uity, Ltd. (P.O. Box 9610).

Davis, Adelle. Let's Cook It Right. New York: New American Library, 1970.

Lazow, Alfred and Nelson, Pearl Astrid. The ABC's of Herbs. Buffalo, New York: D.O.K. Publishers, Inc., 1977. ($2.50 from Academic Media Services, Inc., 415 Fairfax Avenue, Norfolk, Virginia 23507)

Victor, Edward. Science for the Elementary School. New York: The Macmillan Company, 1980.

Worthley, Jean Reese. The Complete Family Nature Guide. Garden City, New York: Doubleday and Company, Inc., 1976.

Zim, Herbert S., Ph.D. and Martin, Alexander C., Ph.D. Flowers, A Guide to Familiar American Wildflowers. New York: Golden Press, 1950.

STUDENT GUIDEBOOK

PLANTS

I. The Study of Nature

A. What's your Nature Quotient?

1. Complete the following test before and after studying this unit. Be sure to answer each question honestly!

   1. List the common and scientific name of three or more trees or shrubs in your yard.

      ____

      ____

      ____

   2. Tell how at least two plants got their names.

      ____

      ____

      ____

   3. Is there any plant you are afraid of? What and why?

      ____

      ____

   4. Tell how each of your senses can be used in nature observation.

      ____

      ____

      ____

      ____

      ____

   5. How many new people have you met on a nature walk or in trying to find out more about a plant?

      ____

      ____

6. Have you ever written to an organization like the Smithsonian Institution or United States Department of Agriculture, contacted a local botanist or farmer, or bought nature books? Explain.

____

____

7. Have you made a nature discovery in the last week, month, year? Tell about it.

____

____

____

8. Approximately how many house plants do you have? Do you know their common and scientific names and plant classification?

____

____

____

9. What famous botanists can you tell about?

____

____

____

10. Tell about three or more plants used for medicinal purposes.

____

____

____

2. Make a chart of before and after NQ scores. Each question is worth 15 points. Your score will fall in the following ranges:

below 55 - - - You are an oak stump!
55 - 69 - - - You are a weed.
70 - 84 - - - You are an herb.
85 - 115 - - - You are a flower bud.
116 - 130 - - - You are a rose bush.
130 - 150 - - - You are a mighty oak.

B. Why Study Nature?

1. Brainstorm "Why Study Nature?" (Be sure to follow the four steps of brainstorming: fluency, flexibility, originality, and elaboration.) Record and rank the top ten reasons.

2. Explain this statement by Richard Adams: "Nature is infinitely patient, resilient, and undiscriminating."

3. Obtain some nature poems by John Clare. Read some of them while you are outside. Appraise their themes and how they make you feel.

4. Look ahead at the topics you will cover in this unit. Write a letter requesting information about some of them.

   Suggested sources:

   Smithsonian Institution
   United States Department of Agriculture
   colleges with a good Botany Department

5. Each student should choose a different botanist for a report. Include factual information about his life, plant experiments, etc. What do you think motivated this person? Describe his/her characteristics and personal values.

II. The Plant Kingdom

A. Plant Classification

1. Describe the seven subdivisions under the Plant Kingdom.

   ____

   ____

   ____

   ____

   ____

   ____

   ____

2. The Plant Kingdom is divided into four major phyla. Construct a flip book describing the characteristics of each.

3. Choose one plant in your yard or home and trace its classification step by step from the phylum to the variety itself as in the example below:

   Classification of Red Delicious Apple

   KINGDOM: Plant
   PHYLUM: Spermatophyta (all seed plants)
   SUBPHYLUM: Angiospermae (flowering plants that produce fruits with seeds)
   CLASS: Dicotyledonae (seeds have two cotyledons)
   ORDER: Rosales (roses and their relatives)
   FAMILY: Rosaceae (produce roselike flowers)
   GENUS: Pyrus (produce apple fruits)
   SPECIES: malus (cultivated apple trees)
   VARIETY: red delicious

4. Design a chart comparing and contrasting "Plants as Living Things" with "Humans as Living Things." Make the chart in the following manner comparing various life processes:

	PLANTS	HUMANS
Cell make-up		
Respiration		
Transpiration		
Digestion		
Circulation		
Excretion		
Reproduction		
Acquisition of food		
Tropism (movement)		

III. Bacteria, Algae, Fungi, Lichens

*A. Experiments with Bacteria

1. Examining bacteria under a microscope.

   a. Make a "transfer needle" (to transfer bacteria) by pushing the sharp end of a needle into a cork. Using the cork as a handle, sterilize the eye of the needle in the flame of a match.

   b. Using the sterilized needle, transfer bacteria to microscope slide.

   c. Add a few drops of diluted coloring agent, such as watered down methylene blue.

   d. Observe the bacteria under a microscope. Draw the different varieties of bacteria you see.

   e. Record your observations and conclusions.

2. Conditions for growth of bacteria.

   a. Prepare six sterile culture dishes containing nutrient culture material.

   b. Use your transfer needle to smear bacteria in each dish.

   c. Place one dish in:

      {(1) a dark, warm place
      (2) refrigerator where it is cold and dark

      {(3) dark, warm place
      (4) bright, sunny, warm place

      {(5) dark, warm, moist place
      (6) dark, warm, dry place (over radiator or hot plate on low heat)

      Each "{" means to compare those two cultures.

   d. Record your observations of the three sets of cultures. Conclude which condition is best for bacteria to grow.

*Caution: Experiments #1 and #2 should be performed by a teacher and require strict controls on the experimental conditions.

B. Thinking Processes - Bacteria

1. Design a chart to categorize your information about bacteria into the following subtopics:

Structure and Kinds of Bacteria	Where Bacteria are Found	Conditions for Growth of Bacteria
1.	1.	1.
2.	2.	
3.	3.	2.
4.	4.	
5.		

2. Research the reproduction of bacteria. (a) Assume reproduction takes place every thirty minutes. Calculate how many bacteria will be formed in five hours from just one bacteria. (b) Make a filmstrip illustrating the reproduction of bacteria.

3. Read about harmful bacteria in a non-fiction source. Compose a science-fiction story about harmful bacteria. Be sure to include facts about harmful bacteria and at least three ways they are combatted.

4. Judge the value of helpful bacteria and write an editorial for your local newspaper.

C. Experiments with Algae

1. Collecting and examining algae

    a. Use large, wide-mouth jars to collect algae from pools, ponds, or lakes. Take along a substantial amount of the water in which the algae were found, but don't put too much algae in one jar.

    b. To get algae from tree bark, pry off a few small pieces of bark, soak in tap water that has been allowed to stand for 24 hours in a large wide-mouth jar (to allow chlorine to escape water). Scrape algae from stones and soak the same way. Keep jars in strong light, not direct sunlight. Label each jar as to where algae was found.

    c. Place a drop of the green material on a microscope slide, cover with cover glass, and examine under low and high powers of your microscope. Observe algae from each collection.

    d. Can you identify any specimens by comparing with pictures from books? Draw the algae you observed.

2. Conditions for growth of algae

    a. Make six specimen jars as you did in Experiment #1 above.

    b. Place one jar each in:

        (1) Complete darkness
        (2) Medium to strong light
        (3) Direct sunlight
        (4) Refrigerator
        (5) Heated radiator
        (6) Room temperature

c. Record observations and conclude in which temperature and type of light algae grows best.

3. Examining seaweed or kelp

    a. Try to obtain some seaweed or kelp from the seashore.

    b. Examine and cut open the air bladders. Look for and examine the cuplike holdfasts.

    c. Record your observations.

D. Thinking Processes - Algae

1. Using information from Experiment #1 and your reading, restate the structure of algae in your own words. Describe the differences between at least two varieties of algae.

    ____

2. Draw a detailed colored cross-cut diagram of kelp. What is kelp or seaweed presently used for? Predict some future uses of seaweed.

3. Appraise the uses of algae and rank these in the order of what you consider are the most important to least important. Write these on construction paper and orally present the list and your reasoning for this order to the class.

E. Experiments with Fungi, Yeast, Mushrooms, and Lichens

1. Collecting and growing molds

    a. Rub a piece of bread across a dusty surface. Use a few drops of water to moisten the bread.

    b. Place the bread in a closed container. Put the container in a warm, dark place.

    c. Record observations after two days.

    ____

    Record observations after 4-5 days.

    ____

d. Look at the mold with a magnifying glass. What do you see?

e. Use a transfer needle to place a bit of the black mold on a microscope slide. Add a drop of water and a drop of coloring agent. Cover with cover glass and examine under high power of microscope. Record observations.

2. Growing and examining yeast cells

   a. Dissolve one teaspoon of sugar in a glass of warm (not hot) water.

   b. Pour in one package (one tablespoon) of yeast. Let stand twenty-four hours.

   c. Use a drop of the yeast culture to make a microscope slide as you have done before. Observe under a microscope.

   d. Record observations.

3. Yeast action on dough

   a. Mix together: 5-6 cups of flour, 1½-2 cups of water, 2 tablespoons of sugar, 1 teaspoon of salt, ¼ cup of oil.

   b. Divide the dough into two equal parts.

   c. Mix one part with a half of a package of dry yeast that has been stirred into warm water.

   d. Place each dough sample in a pan and let stand in a warm place for a few hours.

   e. Record observations.

4. Examining mushrooms and making spore prints

   a. Collect full-grown mushrooms. Examine the stalk, cap, and gills.

   b. Cut away the stalk of the mushroom very carefully and gently.

   c. Coat a piece of thick construction paper with egg white. Use dark paper if spores are light colored. Use light paper if spores are dark colored.

d. Push three toothpicks vertically into sides of mushroom cap so it will stand up ½ inch from paper.

e. Place the cap on the paper and cover with a wide-mouth glass jar to prevent air currents from disturbing the spores.

f. Twenty-four hours later, remove the jar and mushroom cap carefully.

g. Record observations.

5. Collect and examine lichens

a. Collect samples of lichens - gray-green patches on rocks and the bark of trees.

b. Examine under magnifying glass and microscope.

c. Record observations.

F. Thinking Processes - Fungi, Yeast, Mushrooms, and Lichens

1. Report on the "Characteristics of Fungi" by designing a concise outline on a ditto master for the class. Present to the class.

2. Compose a detailed illustrated story on "How Yeast Bread is Made." Include details of the yeast action. Present to the class.

3. Create a fairy tale using facts about the making of wine with grapes. Be sure to explain how and why the process works. Read to the class.

4. Deduce why the mushroom spore prints are permanent outline prints. If you were given only the spore print without the mushroom, what could you tell about the mushroom? Why?

5. Create a comic strip about the symbiotic relationship of fungi and algae in lichens.

IV. Mosses and Liverworts

A. Activities with Mosses and Liverworts

1. Collecting and examining moss

a. Collect the mosses with a little soil. Wrap in damp newspaper.

b. Cut out a few moss plants. Place in shallow water.

c. Examine these plants with a magnifying glass and under a microscope.

d. Record observations.

2. Growing moss

a. Place a wet mixture of rich soil and humus in a pot.

b. Shake some spore cases from growing moss on the soil.

c. Place in medium light and cover with a piece of glass. Water only often enough to keep soil moist.

d. Draw diagrams on your own paper every few days to show life cycle of the moss.

3. Collecting and examining liverworts.

a. Collect liverworts with a little soil. Wrap in damp newspaper.

b. Examine with magnifying glass.

c. Record observations.

B. Thinking Processes - Mosses and Liverworts

1. Pretend you are a spore. Write your complete autobiography from how you were produced until you became a mature plant.

2. Compose a poem about liverworts. Include at least three facts about liverworts.

V. Ferns

A. Activities with ferns

1. Collecting and examining ferns

a. Collect ferns from different localities. Be sure to also dig up rhizomes, roots, and soil with the fern and wrap in damp newspaper.

b. Examine with magnifying glass and low power of microscope.

c. Record observations.

B. Thinking Processes - ferns

1. Criticize the "asparagus fern" that many people have as house plants. Why is it not really a fern? Present your findings to the class as a speech.

2. Examine the role of ferns in the formation of coal. Write a report for the class.

3. Construct a diorama with ferns in their natural habitat.

4. Pretend you are a "Parent Fern." Create an illustrated story about your reproductive cycle.

5. There is much folklore about fern. In the old days some people wore bracken fern in a little bag around their necks to keep them safe and some people believed that a sprinkling of fern spores would make one invisible. Compose one such legend of your own and write a creative story. Include at least five facts about ferns. Read your story to the class.

VI. Weeds and Grasses

A. Activities with Weeds and Grasses

1. Record all the different weeds and grasses found near your house. Give the common name and scientific name of each.

2. Are you one of those lucky people who can take a blade of grass between your thumbs and get a whistling sound when you blow through it? If so, demonstrate to your class.

3. Collect some bamboo which is in the grass family and make some creative project.

4. Press some different shapes of weeds and grasses and make a collage. On the back, identify each plant used.

B. Thinking Processes - Weeds and Grasses

1. Discover the origin or native country of at least ten weeds. Make a chart.

2. Many weeds are edible. Make a book describing at least six weeds. Tell the uses and create at least one recipe for each.

3. Sugar is made from sugarcane, a grass. Write an illustrated report about this process. Share it with the class.

4. Bamboo can be used in so many ways. In Malaysia there is a tiny bat that lives in the hollow stem of a bamboo. Formulate an original use for bamboo and write a science fiction story. Include at least five facts about bamboo. Read your story to the class.

VII. Trees and Shrubs

A. Activities and Thinking Processes with Trees

1. Make a tree a friend. Record its scientific name, origin, description, the region of country where it grows, number of species, etc. Record your own observations of the tree. Make up a creative story about your tree.

2. Formulate a list of all the uses of trees you can find. Then predict future uses of trees.

3. Four classifications of leaves are:

   Collect some from each group and make a collage. On the back, list at least three tree names under each classification.

4. Read about dead trees. How are they useful?

5. Write a letter to the United States Department of Forest Resources. Request information on tree conservation. Write a report about tree conservation. What can you do to help? Could you plan a "Plant a Tree Day?"

B. Activities and Thinking Process with Shrubs

1. Record all the trees and shrubs in your yard. Draw a labeled map. On the back tell the scientific name and plant classification of each.

VIII. Flowers

A. Activities and thinking processes

1. In using the learning center, "Persevering Periwinkles," choose three cards from each of the three areas: Ingenuity, Potpourri, Serendipity.

2. Grow different varieties of flowers or bring flowers from your home or woods to accompany the learning center.

3. Learn how to press flowers or to dry them with silica gel (follow directions on package).

IX. Herbs

Use The ABC's of Herbs by Alfred Lazow and Pearl Nelson, DOK Publishers, Inc.
For each of twenty-six herbs, a poem, description, and recipe are included.

A. Activities and Thinking Processes

1. Choose one or two herbs, prepare the recipe and serve to your classmates.

2. Grow one of the herbs and design and prepare your own recipe.

3. Create a 3-way matching game on poster board with names, pictures, and descriptions of herbs. Let your classmates play the game.

4. Write a paragraph in which you appraise the value of using herbs. Support your position with facts.

X. Plants as Medicine

A. Thinking Processes

1. Construct a chart recording the following plants, a drug derived from each, and the illness for which the drug is used:

   a. foxglove
   b. papaver somniferum
   c. cannabis sativa
   d. ergot
   e. madagascar periwinkle
   f. erythroxylon coca
   g. ginseng
   h. willow
   i. dandelion
   j. sassafras
   k. rauwolfia
   l. aloe vera
   m. ouabain
   n. curare
   o. peyote
   p. cola
   q. calabar beans

   (Information may be found in "Nature's Gifts to Medicine," National Geographic, September, 1974.)

2. Learn all that you can about one of the following men. Create a play to dramatize his discovery.

   Dr. Jonathan Hartwell
   Dr. Robert L. Noble
   Dr. Rauwolf
   Richard Evans Schultes
   Richard Spruce
   Nicolas Monardes
   Friedrich Serturner

3. Choose one medicinal plant and create a folklore story about it. Include facts about the plant and its real uses.

XI. Field Trip Book

(To be completed at the site during the planned activities.)

A. ABC Scavenger Hunt

Locate objects that begin with the letters of the alphabet. See how many you can find.

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

B. Pond or Stream Habitat

Words to know: silt, "critter," humus, water shed, monocot, dicot.

Materials needed: pencil, magnifying glass, glue

1. Name 10 things that can live in a pond.

______________ ______________

______________ ______________

______________ ______________

______________ ______________

______________ ______________

2. Name some things you can actually see living in the pond.

3. Scoop up some silt from the bottom of the pond. Look at it with a magnifying glass. Record your observations and conclusions as to identification of what you see.

4. Locate a "critter." Sit still and observe it for five minutes. Describe its physical appearance and behavior.

5. Look for signs of soil erosion around the pond or stream. Record Observations. Do you see any signs of man-made soil erosion prevention? Describe.

6. Find a "water shed" and describe it.

7. In which direction does the creek flow?

8. Smell a handful of humus. What does it smell like? What is it made of?

9. Is the water in the pond safe to drink? Why?

10. Give the names of five trees you see and record distinguishing characteristics from other trees.

11. Find a monocot leaf and a dicot leaf. Draw a picture of each and tell the difference.

C. Nature Walk with the Park Ranger

1. List the things you observed on your "expedition" with the Park Ranger. These can be man-made or natural.

    a.
    b.
    c.
    d.
    e.
    f.
    g.
    h.
    i.
    j.

2. Think of ways Daniel Boone or early pioneers could have used objects from nature to make signs or symbols to mark a trail for someone else to follow. Sketch three signs that can be used or made today. Label what each means and what natural things you would use to make it. Then make at least one of them. (You may make all three if you like.)

D. Creativity in Nature

1. Haiku is a form of Japanese poetry which is structured in the following pattern:

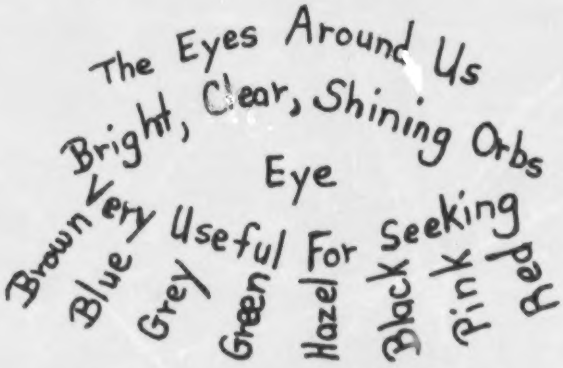
   Line 1: 5 syllables
   Line 2: 7 syllables
   Line 3: 5 syllables

   Each haiku includes a word or expression indicating the time of year. The goal is suggestion. Nature and natural phenomena are used to reflect human emotions. There is usually a comparison of two or more ideas.

   Example:
   Blossoms on the pear
   A woman in the moonlight
   Waits for someone there.

   While sitting quietly and alone, write your own "Nature Haiku."

2. Like a Rock: Concrete Poems
   Concrete or shape poems are written to represent the objects which they describe. Example:


The Eyes Around Us
Bright, Clear, Shining Orbs
Eye
Very Useful For Seeking
Brown
Blue
Grey
Green
Hazel
Black
Pink
Red

Create your own concrete poem about something in nature.

3. Take Five!

Cinquain poetry is a form of poetry with the following structure:

		Example:
Line 1:	One word giving title	Kittens
Line 2:	Two words describing title	Soft, tiny
Line 3:	Three words expressing action	Mewing, sleeping, tumbling,
Line 4:	Four words expressing feeling	Warm against my cheek
Line 5:	One word synonym for title	Love

Compose your own cinquain about something you see, hear, smell, touch, or taste in nature.

4. Creating with Natural Items!

Collect: 1 acorn
1 piece of tree bark
3 pieces of pine straw
1 brown leaf
1 green leaf
2 seed pods
1 pine cone

Create something! Name it and tell your classmates about it in an "on the spot" creative story.

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A HANDBOOK ABOUT GIFTED EDUCATION FOR PARENTS, TEACHERS, AND YOU

LEE COUNTY SCHOOLS
PROGRAMS FOR
EXCEPTIONAL CHILDREN
BOX 1010
SANFORD, N.C. 27330

This handbook has grown out of the needs of parents, students, and ourselves as educators to explain what is the Gifted/Talented Program. This task is difficult because there is no national definition of giftedness. One state defines gifted children by I.Q. alone; another by I.Q. and achievement; and in North Carolina by I.Q., achievement, behavioral rating scale and grades. The North Carolina definition tends to define the academically gifted child.

As I've studied gifted programming, I've observed the following about gifted students. As a group, these students have a critical attitude of themselves and others, have a tremendous need for success, are sensitive to peer group rejection, are stubborn, verbal, easily frustrated, gullible, resist direction, and dislike routine and drill. Sometimes these students invent their own system for doing things. Sometimes "their system" conflicts with "the way it should be done." When conformity is demanded by the adults such as parent and teacher, this demand can lead to rebellion by the student. These characteristics often lead to problems for the child in the normal world where we and the child reside.

Why have a program for gifted children? Can't they get along without any special help? These students may "get along;" however, we are committed to helping every child achieve to his maximum potential. Yes, these students are like other students in many ways; however, they do need and should receive differentiated instruction and guidance from specially trained teachers.

The program objectives for the gifted are:

1. Sensitize teachers and parents to the accelerated developmental needs of gifted students.
2. Develop a means of achieving and maintaining curriculum flexibility.
3. Extend the learning environment beyond classroom and school building.

I hope this handbook will serve as a guide as you work and live with these children. I would appreciate any comments or suggestions you would have. Remember - these children have abilities and "unto whom much is given, much is expected".

Linda S. Marsal
Director of Exceptional Children

I better hurry if I want to find out what G.T. is.
Angela Hammonds
Broadway Elementary
Grade 6

GT is . . .

--original work that is fun and creative. It is putting your mind to work. It is thinking flexibly, fluently, originally, and elaborately. It can be fun for the whole world. Alan Bonard, 4th grade, W.B. Wicker Elementary School.

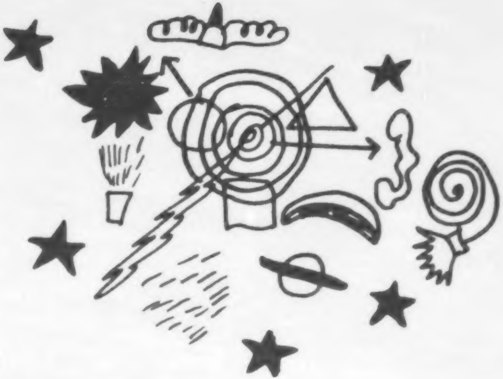
--If it wasn't for GT I think my life would be about as dull as a dull knife. And I enjoy everything that we do. Renee Harrison, 5th grade, McIver Elementary School.

--We learn more about ourselves and our surroundings. We do exciting projects and teach other people. Jeff Johnson, 6th grade, Jonesboro Elementary School.

--is exciting, delighting, fabricating, breathtaking, and downright uptight. Dennis Oliver, 5th grade, Deep River Elementary School

--learning to be able to help others in trying to improve this world. Wendy Key, 4th grade, Greenwood Elementary School.

--another dimension in learning. Matthew Seamen, 6th grade, W.B. Wicker Elementary School.



--full of imagination,
Having an application,
Reviewing comprehension,
Making compositions.
You get full of knowledge
And maybe we'll go to college.
Rena Bolitho, 6th grade
Deep River Elementary School

--sometimes knowing more than your parents.
Carmen Cox, 4th grade, Broadway Elementary School

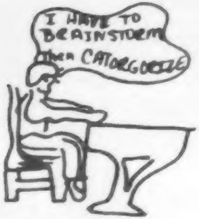
--I think it is fun in the GT class because your brain seems to grow. Penny Knight, 6th grade, McIver Elementary School

--going on trips, making plays, and doing lots of work. Most of this takes people working together. Edna Bryant, 4th grade, Greenwood Elementary School

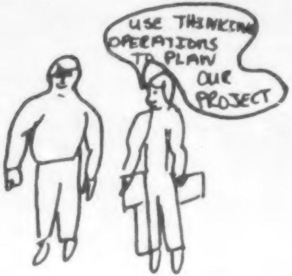
--having a chance to do what others can't do. You also feel rare and proud.
Todd Walls, 5th grade, Jonesboro Elementary School

--I think GT is the abbreviation for a "great time". Stephanie Brown, 5th grade, Broadway Elementary School

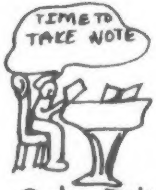
GT is....


I HAVE TO BRAINSTORM then CATORGORIZE

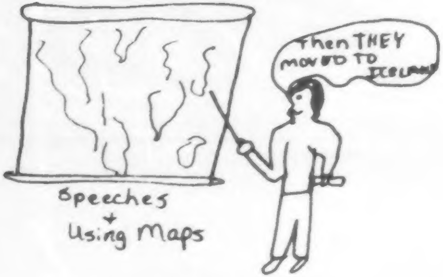
Brainstorming
↓
Catorgorizing
Ideas


USE THINKING OPERATIONS TO PLAN OUR PROJECT

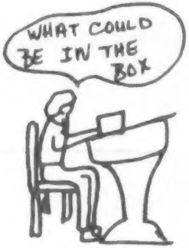
Project Planning


TIME TO TAKE NOTE

Note Taking
&
Reading


Then THEY MOVED TO ICELAND

Speeches
+
Using Maps


WHAT COULD BE IN THE BOX

Activities

Robb Clarke
W. B. Wicker
Grade 5th

CHARACTERISTICS OF G/T RESOURCE ROOMS..........

Creative thinking...using fluency, flexibility, originality, elaboration
Activities...fostering quick thinking and quick responses
Conscious development of...thinking processes, self concepts, awareness of others
Small group planning
Student teaching units
In-depth studies
Bloom's Taxonomy...Writing questions from each level
Pupil self-evaluations
Lots of synthesizing
Planning projects
Emphasis on oral sharing

CHARACTERISTICS OF GT RESOURCE ROOMS

BLOOM'S TAXONOMY

VI. Evaluation

make decisions or judgments based on chosen criteria, or standards

----

evaluate, rank, decide, rate, choose, put in, order, award, grade, assess, determine, criticize, justify, defend, reveal, dispute, measure, conclude,

V. Synthesis

use elements or ideas in new, and original patterns and relationships

----

make, create, develop, devise, originate, blend, produce, blend, predict, invent, design, compose, imagine, contrast, compare, form, suppose, build, reorganize, alternate, estimate,

IV. Analysis

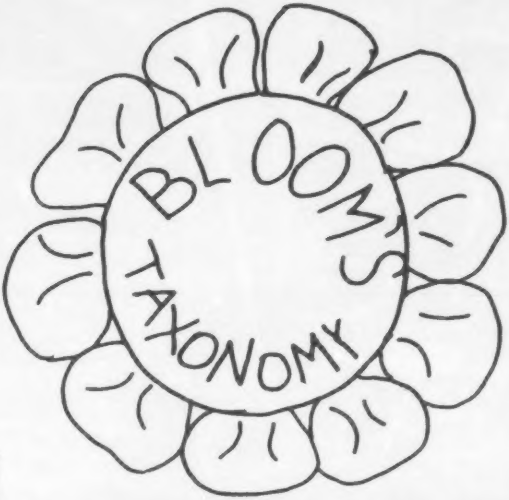
take apart or break down a thing or idea into parts and perceive the interrelationships

----

analyze, sort, discover, reduce, separate, group, identify parts, examine, inspect survey, divide, search, classify simplify, test for study, dissect

Benjamin Bloom is psychologist who designed a system (taxonomy) for classifying educational objectives. The objectives were designed to aid teachers in developing curriculum and in class planning. These objectives form the core of the gifted/talented progran in Lee County and represent the different levels of thinking children learn.

Taxonomy of Educational Objectives in Handbook I. Cognitive Domain.
New York: David McKay Co., 1956



. Application

e learned
owledge, rules
eas, methods
new situations

----

ply, employ.

lve, use, try,
ake us of,
nstruct using,
lect, record,
monstrate,
odel, interview,
oose, operate,
ndle, relate,
t into action,
t together,
periment with,
ilize

II. Comprehension

communicate knowledge and interpret previous learnings

----

explain, reword,
reorganize,
restate, outline,
translate, change,
summerize, show,
interpret, define,
propose, expand,
alter, transform,
vary, submit,
account for,
convert, offer,
spell out

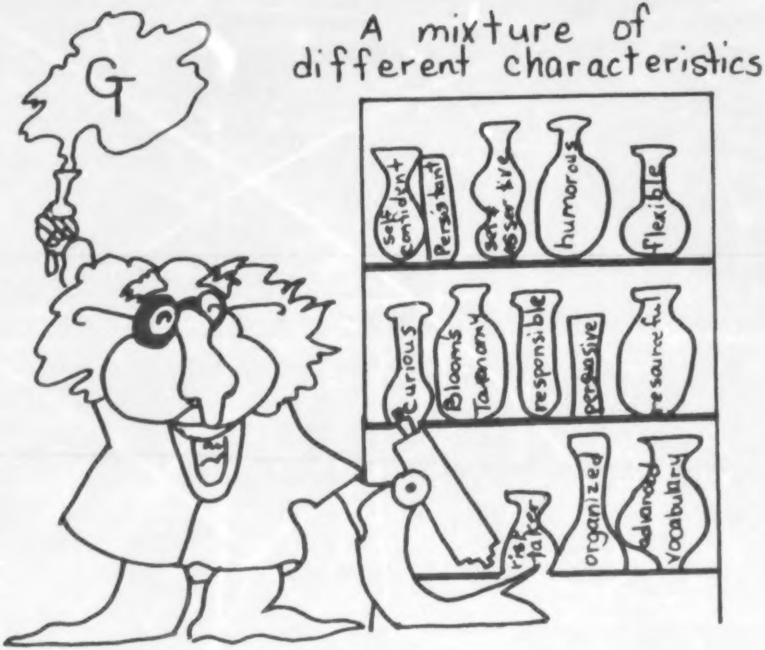
I. Knowledge

learning specific facts, vocabulary, ideas, and reiterate them in similar form

----

match, list,
write, recite,
identify, find,
group, say, tell
name, locate,
label, choose,
recall, arrange,
memorize, what,
underline, spell
observe, and
write who, know,
pick

GT is.....


A mixture of
different characteristics
GT
self confident
Persistant
self assertive
humorous
flexible
curious
Blooms Taxonomy
responsible
persuasive
resourceful
risk taker
organized
advanced Vocabulary

IDENTIFICATION OF GIFTED AND TALENTED STUDENTS

In Lee County identification of Gifted and Talented students consists of a screening and evaluation procedure which follows the requirements of the State Department of Public Instruction, Division of Exceptional Children. These requirements are:

1. An achievement level evaluation - Statewide assessment test scores in the areas of Reading and/or Math are used.
2. A Behavioral Characteristics Scale - The student's teacher(s) evaluate the student's learning, motivational, creative and leadership characteristics.
3. An intellectual assessment - A group test is used for screening purposes.
4. A classroom performance evaluation based on grades or teacher rating.

State laws require that identification of students must be accomplished by multiple means with consideration given to the total minority population of the school and to gifted children who are handicapped. A school-based committee evaluates the information on each student and makes a recommendation for placement or nonplacement in a G/T Program to the Administrative Placement Committee who makes the final decision. After a student has been identified, an Individual Education Plan (I.E.P.) must be written and signed by the members of the school-based committee and parent to complete placement procedures.

Each identified student's performance is reviewed annually and an in depth re-evaluation is conducted every three years. A student may be removed from the program at any time upon recommendation to the school-based committee by the parent, principal, or Director of the Exceptional Children's Program.

THE THREE R's FOR THE PARENTS OF GIFTED CHILDREN

Does parenting the gifted child make you a gifted parent? It **can** make special demands of you in a role that is always challenging, regardless of your child's abilities. Labelling a child does not change your commitment to love and nurture. Some points for the parent of a gifted child to consider are rights, responsibilities, and resourcefulness.

Rights

1. The gifted child has a right to an appropriate education - one that challenges and stimulates him/her in both academic and social areas.
2. The gifted child has a right to be respected for his talents and for the limits of his talents.
3. The gifted child has a right to make his/her own choices. This includes the right to risk failure.
4. The gifted child has the right to be a whole person. Watching sunsets and playing with friends with various abilities can be as valuable for maturation as organized activities. Not all learning comes from books. Don't be awed by the child. Don't stifle creativity for the sake of order.
5. The gifted child has a right to achieve because he/she wants to. He/she is not you. Successes and failures belong to the child. You must not expect to take credit or blame for them. You should not expect more of your child than you would of yourself. We all deserve to determine our own goals.
6. The gifted child has a right to every experience that will lift his/her vision, broaden his/her horizons, and lead to becoming a more responsible citizen.

Responsibilities

1. The gifted child has the responsibility of developing his/her talents to the fullest.
2. The gifted child has the responsibility of using his/her talents with dignity and respect for self and others.
3. The gifted child has the responsibility of trying to be a well-rounded person.
4. The gifted child has the responsibility of being part of the problem-solving process which guarantees him/her an appropriate educational environment.

Resourcefulness

The gifted child and his parents must be resourceful. Together and separately you must seek out new horizons. Encourage your child to find answers to his/her questions wherever possible-peers, informed adults, museums, newspapers.

Be a good example. Be a seeking person yourself. Let your child see you asking questions and finding answers, solving problems with the help of community resources. Write a letter, look it up, call someone, ask your mother, take a course.

Enjoy your gifted child. Guide and applaud him/her as he/she grows into a gifted adult.

Advice 7¢
That's All? That's it?

AND MORE FROM THE CHILDREN...

--terrific! It makes me specific. Carol Estes, 5th grade, Deep River Elementary School.

--We can face the world and cope with our problems and find out what is wrong. Shelli Hamer, 4th grade, Greenwood Elementary School.

--A place to not only learn what you see, but to see what you learn. Rosilyn Sharpe, 6th grade, Broadway Elementary School.

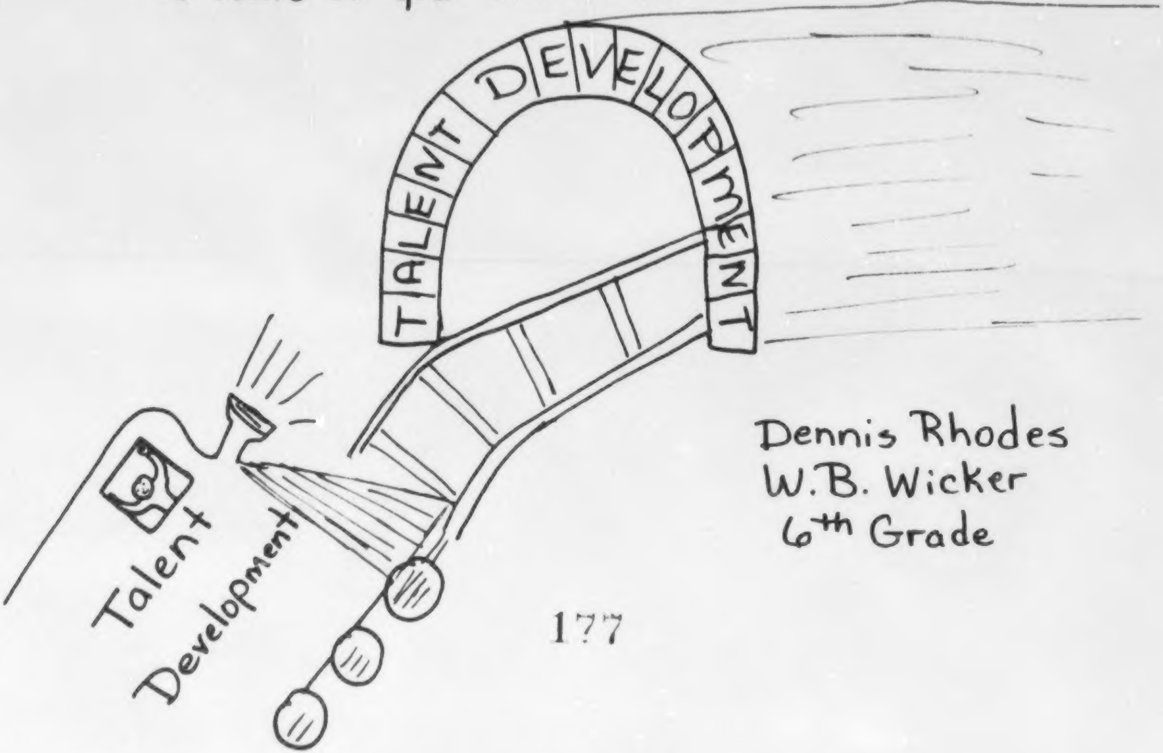
--I like G.T. because it gives us a chance to have freedom of the brain. G.T. is a place that meets our needs. Sheila Thomas, 6th grade, Jonesboro Elementary School.

--I think of how I improved since I joined the class and I think I have carried out the purpose of the class. Guy Taylor, 6th grade, Jonesboro Elementary School.

--Talent Development is fun.
For each and everyone.
You comprehend,
And evaluate,
And sometimes even
Applicate.
You do some plays,
And model with clays,
And that's why it's fun
For each and everyone.

Winfred Shaw
4th grade, W.B. Wicker

So Come on aboard and ride the train
To a brand new place and time,
To explore strange new places, and find a way
To leave all your worries behind.


TALENT DEVELOPMENT
Talent Development

Dennis Rhodes
W.B. Wicker
6th Grade

The Spirit of GT (sung to the tune of the Caisson Song)

Over desk
Over chair
Look around
It's in the air
We are GT's, we're here to stay.
We will read
We will learn
We will always
Be concerned
For our classmates along the way.
Thinking of the old, unexplained,
And never told.
We will learn more about them
Day by day.
We'll be ready, brave and strong,
Singing now our GT song,
As the GT's go learning along.

Noel Shepherd
6th grade, W.B. Wicker Elementary School

This pamphlet was prepared by:
Margaret Baggarley, Carolina Chappell, Celia Dickerson,
Priscilla Dollar, Hilda Hobson, Linda Marsal,
Lenore Yow, and OUR STUDENTS.